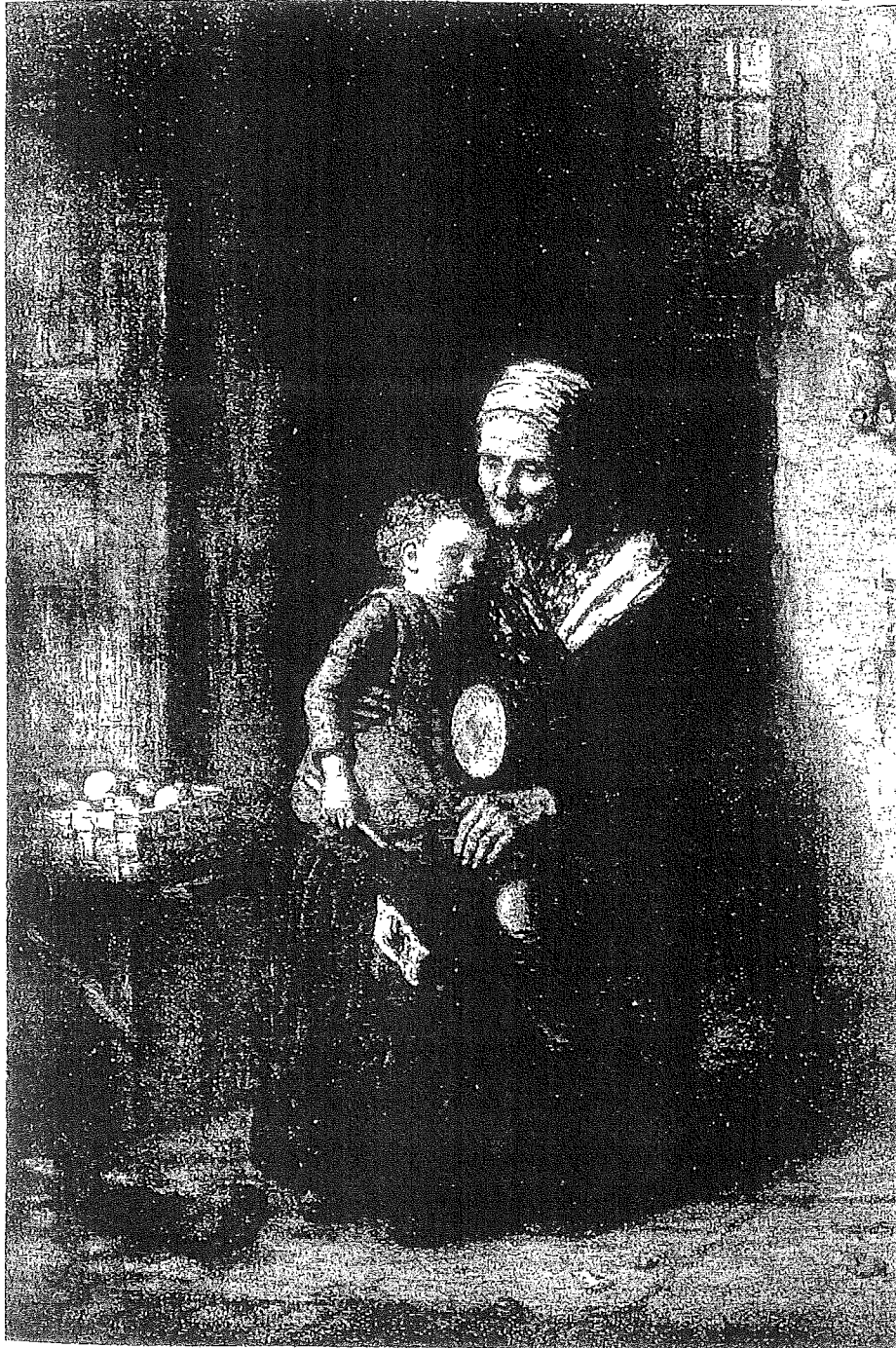


THE DEVELOPMENT OF
INFANT SLEEP:
IMPLICATIONS FOR THE
PREVENTION OF INFANT SLEEP
DISTURBANCE

A thesis
submitted in partial fulfilment
of the requirements for the degree
of
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Jacqueline Mary Therese Henderson

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"O SLEEP! IT IS A GENTLE THING!"



THE MINISTRY OF SLEEP, MOST NEEDED BY THE TIRED CHILD. BY MR. HUGH CAMERON

3835

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ABSTRACT

This thesis reviews the literature on the development of infant sleep to establish whether relevant criteria for planning primary preventive intervention of infant sleep disturbance (ISD), derived from Mrazek and Haggerty's (1994) criteria for evaluating prevention interventions, have been met. It concludes that the methodological and conceptual limitations of this literature have prevented the two most critical criteria from being met. These are, when preventive intervention should occur, and what specific infant and parent factors should be targeted.

In order to address these criteria a prospective longitudinal repeated measures design was employed. Parents of 75 normally developing infants, 52 from the age of 1 month, and 23 from the age of 2 months completed sleep diaries for six consecutive days, each month until the infant had reached 12 months of age. All night, infra-red, time-lapse video recording (TLVR) was also obtained for the purpose of reliability.

There were two separate studies. The first challenged traditional definitions of sleeping through and demonstrated an 8 hour criterion to be behaviourally meaningful and developmentally realistic. It then investigated the norms for this developmental task. The results indicated the optimal time for prevention to be within the first 2 months. By six months two discrete group of infants were identified, one group with emerging sleep disturbance and the other demonstrating settled sleep. Stability in infants' relative sleep scores was demonstrated across the first 12 months although many parents intervened.

The second study tested the predictions from a developmental model (France & Blampied, 1999) which suggested the proximal parent and infant risk factors that precede and predict ISD. At 1 month a discriminant function analysis identified 3 variables that correctly classified 90.4% of the infants into either a group of infants with emerging sleep disturbance or a group without sleep disturbance at 6 months of age. Two of these 3 variables also predicted group membership at 12 months.

This research has filled some critical gaps in the research base by identifying parent and infant factors to be targeted, and the optimal time for prevention. It empirically supports and extends the developmental model, thereby providing a framework for planning primary prevention of ISD. Several directions for future research are presented.

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CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	v
LIST OF TABLES	x
LIST OF FIGURES	xi
OVERVIEW OF THE THESIS	1
PART ONE: LITERATURE REVIEW	4
CHAPTER ONE: INFANT SLEEP DISTURBANCE	5
1.1. TERMINOLOGY, DEFINITIONS AND CRITERIA	5
1.1.1. Terms Used in the Study of Infant Sleep	5
1.1.2. Definitions of the Target Group: Infancy and Prevention Level	6
1.1.3. Definitions of Sleep Disturbance in Infancy	7
1.1.4. Definitions of the Components of Infant Sleep	7
1.1.5. Criteria for ISD	8
1.1.6. Age ISD is Defined in the Management Literature and Normative Studies	11
1.2. MEASUREMENT OF INFANT SLEEP	13
1.2.1. Parent Report	13
1.2.2. Methods of Employing Direct Observation	14
1.2.3. Most Commonly Used Measures by Investigators	14
1.2.4. Validity of Parent Report	14
1.2.5. Hierarchy of Measures	14
1.3. SUMMARY	16
1.4. CONCLUSION	17
CHAPTER TWO: THE PREVALENCE AND PERSISTENCE OF INFANT SLEEP DISTURBANCE	18
2.1. THE PREVALENCE OF ISD	18
2.1.1. Night Waking	19
2.1.2. Sleep-Onset Delay and Bed-Time Delay	19
2.2. THE PERSISTENCE OF ISD	22
2.3. METHODOLOGICAL DRAWBACKS OF PREVALENCE AND PERSISTENCE STUDIES	22
2.3.1. Samples Used	23
2.3.2. Lack of Direct Measures	23
2.3.3. Hierarchy of Measures	23
2.3.4. Diversity of Definitions and Strategies	23
2.3.5. Lack of Data for Specific Age Points	24
2.4. SUMMARY	24
2.5. CONCLUSION	25
CHAPTER THREE: RISK AND PROTECTIVE FACTORS ASSOCIATED WITH INFANT SLEEP DISTURBANCE	26
3.1. FACTORS WITH A "WEAK" OR "INCONCLUSIVE" ASSOCIATION	27

3.1.1. Individual Characteristics of the Infant.....	27
3.1.2. Family Composition and Characteristics.....	33
3.2. FACTORS WITH A STRONG ASSOCIATION.....	35
3.2.1. Individual Characteristics of the Infant.....	35
3.2.2. Parental Handling Practices.....	38
3.2.3. Parental Factors	42
3.3. EFFECTS OF ISD.....	43
3.3.1. Family/Marital Stress	43
3.3.2. Effects of ISD on the Infant.....	44
3.4. FACTORS ASSISTING ORGANISED SLEEP DEVELOPMENT.....	44
3.4.1. Self-Soothing Behaviours.....	45
3.4.2. Leaving Infants to Settle Alone with Scheduled Feeding and Sleeping Routines.....	45
3.5. METHODOLOGICAL CONSIDERATIONS	45
3.5.1. Problems of Interpretation.....	46
3.5.2. Problems in Execution.....	48
3.5. SUMMARY.....	50
3.6. CONCLUSION.....	51
 CHAPTER FOUR: WHAT THE MANAGEMENT LITERATURE CAN TEACH ABOUT PREVENTION	 52
4.1. OPERANT PRINCIPLES AND PARENT BEHAVIOUR.....	53
4.1.1. The Power of Stimulus Control.....	53
4.1.2. The Power Of Reinforcement.....	54
4.2. EFFICACY OF STUDIES EMPLOYING OPERANT PRINCIPLES.....	56
4.2.1. Studies Employing Stimulus Control.....	56
4.2.2. Studies Employing Extinction.....	57
4.2.3. How the PERB can Thwart Parental Attempts at Intervention.....	58
4.3. IMPLICATIONS FOR PREVENTIVE INTERVENTION.....	58
4.4. SUMMARY.....	60
4.5. CONCLUSION.....	60
 CHAPTER FIVE: PREVENTIVE INTERVENTION FOR INFANT SLEEP DISTURBANCE.....	 62
5.1. DESCRIPTION OF THE INTERVENTIONS	63
5.1.1. Goals and Intervention Protocols of the Five Studies	63
5.1.2. Personnel and Site of Intervention.....	67
5.1.3. Method of Delivery	67
5.1.4. Exposure to Intervention	68
5.1.5. Measures of Infant Sleep.....	69
5.2. DESCRIPTION OF THE RESEARCH METHODOLOGIES AND ADHERENCE	71
5.2.1. Recruitment, Sample Size and Randomisation.....	71
5.2.2. Baseline Measures and Attrition of Subjects.....	71
5.3. OUTCOMES OF THE PREVENTION STUDIES	71
5.4. USE OF OPERANT PRINCIPLES BY THE PREVENTIVE STUDIES	76
5.5. SUMMARY.....	77
5.6. CONCLUSION.....	78

CHAPTER SIX: DEVELOPMENTAL PROCESSES IN INFANT SLEEP	80
6.1. THE DEVELOPMENT OF SLEEP-STATE ORGANISATION	81
6.1.1. The Ultradian Organisation of the REM/NREM Cycle.....	81
6.1.2. Diurnal Organisation of Infant Sleep: Regulation of the Sleep-Wake Cycle.....	83
6.1.3. Summary of Sleep-State Organisation	84
6.2. "SLEEPING THROUGH THE NIGHT": THE CONSOLIDATION OF INFANT SLEEP-WAKE PATTERNS.....	85
6.2.1. The Longest Sleep Period (LSP).....	87
6.2.2. The Longest Uninterrupted Sleep Period (LUSP).....	88
6.2.3. Sleeping Through The Night.....	92
6.3. GENERAL COMMENT.....	97
6.4. SUMMARY.....	97
6.5. CONCLUSION.....	97
CHAPTER SEVEN: EXPLANATORY MODELS OF INFANT SLEEP DISTURBANCE	99
7.1. A GENERIC MODEL.....	99
7.2. TRANSACTIONAL SYSTEMS MODEL	100
7.3. BEHAVIOURAL MODELS	101
7.4. DEVELOPMENTAL MODELS.....	101
7.5. IMPLICATIONS FOR PREVENTION.....	104
7.6. SUMMARY AND CONCLUSION.....	106
CHAPTER EIGHT: RATIONALE AND AIMS	108
8.1. WHEN IS THE OPTIMAL TIME FOR PREVENTIVE INTERVENTION?.....	110
8.2. HOW SHOULD PREVENTIVE INTERVENTION BE CONDUCTED?.....	111
PART TWO: THE STUDIES	112
CHAPTER NINE: METHOD COMMON TO BOTH STUDIES	113
9.1. DESIGN	113
9.2. PARTICIPANTS.....	113
9.2.1. Characteristics of the Participants.....	115
9.2.2. Characteristics of Non-Responders.....	115
9.2.3. Recruitment Procedures.....	115
9.3. MEASURES.....	117
9.3.1. Sleep Diaries	117
9.4. RELIABILITY	121
9.4.1. Reliability Assessment	121
CHAPTER TEN: STUDY ONE: TIMING PREVENTIVE INTERVENTIONS	123
10.1. INTRODUCTION.....	123
10.2. METHOD.....	129
10.2.1. Design	129
10.2.2. Participants and Setting	129
10.2.3. Measures.....	129

10.2.4. Data Analysis Procedure	130
10.3. RESULTS	133
10.3.1. Section One: Characteristics of the Data	133
10.3.2. Section Two: Sleeping Through the Night	134
10.3.3. Section Three: Comparison of Three Different Criteria for Sleeping Through the Night	137
10.3.4. Section Four: The Longest Uninterrupted Sleep Period	143
10.3.5. Section Five: Distribution of Sleep Behaviour Scores	147
10.4. DISCUSSION	152
10.4.1. Establishing Norms for Sleeping Through the Night	152
10.4.2. Examining the Utility of the Moore and Ucko (1957) Criterion, the 8-Hour Criterion, and the 10:00 p.m. to 6:00 a.m. Criterion	153
10.4.3. The Longest Uninterrupted Sleep Period	155
10.4.4. Distribution of SBS Scores	156

CHAPTER ELEVEN: STUDY TWO: CHOOSING PREVENTIVE INTERVENTIONS FOR INFANT SLEEP DISTURBANCE..... 161

11.1. INTRODUCTION	161
11.2. METHOD	165
11.2.1. Design, Setting and Procedures	165
11.2.2. Participants	165
11.3. MEASURES	165
11.3.1. Dependent Variables	165
11.3.2. Independent Variables	166
11.4. PROCEDURE FOR DATA ANALYSIS	168
11.4.1. Comparative Analyses	168
11.4.2. Discriminant Function Analysis	168
11.5. RESULTS	170
11.5.1. Section I: 6 Month Data	170
11.5.2. Section II: 12 Month Data	175
11.6. DISCUSSION	179
11.6.1. Comparative Analyses of Predictor Variables	179
11.6.2. Predictors of Group Membership at 6 and 12 Months of Age	181

CHAPTER TWELVE: DISCUSSION..... 186

12.1. THE DEGREE TO WHICH CRITERIA FOR PLANNING PREVENTION HAVE BEEN MET	186
12.1.1. Criterion 1: Identification of ISD and Description of the Target Population	187
12.1.2. Criterion 2: Demonstration that the Population is Actually at Risk of the Disorder	187
12.1.3. Criterion 3: Evidence of Risk Factors, and of their Role in the Development of ISD	188
12.1.4. Criterion 4: Preventive Intervention Must be Based on a Relevant Developmental Task	189
12.1.5. Criterion 5: A Theoretical Model Needs to be Identified	190
12.2. IMPLICATIONS OF THE FINDINGS	190
12.2.1. Developmental Changes in Sleep-Wake Organisation	192
12.2.2. Infant Characteristics and Parent Practices	192

12.3. IMPLICATIONS FOR PLANNING PRIMARY PREVENTION OF INFANT SLEEP DISTURBANCE	194
12.3.1. Timing for Parent Training.....	194
12.3.2. Timing for Preventive Intervention.....	195
12.3.3. Implications for Teaching Parents Skills for Preventive Intervention	195
12.4. THE UNIQUE CONTRIBUTIONS OF THIS RESEARCH TO THE AREA OF INFANT SLEEP.....	199
12.5. LIMITATIONS	200
12.6. DIRECTIONS FOR FUTURE RESEARCH	202
REFERENCES	205
APPENDICES.....	222
A. Flyers for Recruitment	222
B. Ethical Approval.....	226
C. Parent's Information and Consent Forms	228
D. 8 Month and 12 Month "Thank You" Letters.....	233
E. Sleep Questionnaire.....	236
F. Sleep Diaries.....	238
G. Methods of Computing Scores on the Sleep Behaviour Scale (From Richman, 1981).....	241
H. T-tests Between the Two Groups at Age of Entry	243
I. Life Tables.....	245
J. Intervention.....	248

LIST OF TABLES

Table 1.	The prevalence of infant sleep disturbance	20
Table 2.	Infant characteristics associated with infant sleep disturbance.....	28
Table 3.	Environmental and parental factors associated with infant sleep disturbance.....	32
Table 4.	The relationship between parental practices and infant sleep disturbance	40
Table 5.	Description of preventive intervention programmes.....	65
Table 6.	Description of the research methodologies and evidence concerning implementation	70
Table 7.	Description of evidence concerning outcomes.....	72
Table 8.	Behavioural principles as components of preventive interventions.....	75
Table 9.	The Longest Sleep Period (LSP) in minutes from direct recording.....	86
Table 10.	The duration (hours) of the Longest Uninterrupted Sleep Period (LUSP) during infancy	89
Table 11.	Percent of infants "sleeping through the night" across the first year	93
Table 12.	Sociodemographic characteristics of the participants.....	114
Table 13.	Reliability of time down, infant state, frequency of night awakenings, and time up. Parent records measured against time-lapse video records.....	122
Table 14.	Number of diaries received for infants at each age over the first 12 months	133
Table 15.	Comparisons of the three different criteria using the Gehan Wilcoxon test.....	137
Table 16.	Correlations for all infants between 2, 6 and 12 months.....	148
Table 17.	Pre-and Post-intervention SBS scores: Parent intervention.	150
Table 18.	Comparison table for Table 5: SBS scores for infant without parent intervention comparable to pre- and post-intervention ages	150
Table 19.	Means and standard deviations of predictor variables at 1 month for the NSD and SD groups	170
Table 20.	Parental presence.....	171
Table 21.	Put down asleep	171
Table 22.	Co-sleeping.....	171
Table 23.	Canonical discriminant functions for SD/NSD group membership.....	172
Table 24.	Standardised Canonical Discriminant Function coefficients of 1 month predictor variables	173
Table 25.	Classification matrix for group membership.....	174
Table 26.	Means and standard deviations of predictor variables at 1 month for the NSD and SD groups	175
Table 27.	Parental presence.....	176
Table 28.	Put down asleep	176
Table 29.	Co-sleeping.....	176
Table 30.	Canonical Discriminant Functions for group membership.....	177
Table 31.	Standardised Canonical Discriminant Function coefficients of 1 month predictor variables	178
Table 32.	Classification matrix for group membership.....	178

LIST OF FIGURES

Figure 1.	The three coordinated models of ISD presented by France and Blampied (1999).....	102
Figure 2.	The cumulative percentage of infants who met the Moore and Ucko (1957) criterion over the first year of life	135
Figure 3.	The cumulative percentage of infants who met the first three criteria over the first year of life	136
Figure 4.	The cumulative proportion surviving under each criterion.....	138
Figure 5.	Survivor and hazard functions for the Moore and Ucko criterion.....	140
Figure 6.	Survivor and hazard functions for the 8-hour criterion.....	141
Figure 7.	Survivor and hazard functions for the 10:00 p.m. to 6:00 a.m. criterion.....	142
Figure 8.	Mean start time and the mean LUSP in infants	144
Figure 9.	The distribution of SBS scores over the first twelve months.....	145
Figure 10.	The mean SBS scores and standard errors for NSD and SD groups from 1 month to 24 month follow-up	148
Figure 11.	The ages of infants when parents initiated intervention.....	151
Figure 12.	The establishment of sleep initiation problems during the first three months of life.....	191

OVERVIEW OF THE THESIS

It is only through prospective longitudinal research from a developmental psychopathology framework that prevention scientists can understand the emergence and course of a disorder, as well as the processes through which risk and protective factors operate. In turn, this knowledge is essential for designing effective interventions to prevent the disorder.

(Coie, Miller-Johnson & Bagwell, 2000, p. 99)

The aim of this thesis is to provide a framework for the development of an effective and empirically validated prevention intervention study for infant sleep disturbance (ISD). Coie et al. (2000) assert that preventive intervention must be based on developmental research which predicts factors controlling developmental trajectories and deviations from them. In concert with this principle, a prospective longitudinal study was employed in order to track normative development and identify factors influencing whether infants sleep was settled or became disturbed. This information, together with certain relevant criteria, suggested by the Committee on Prevention of Mental Disorders for the Institute of Medicine (Mrazek & Haggerty, 1994) for the evaluation of preventive interventions has been employed in planning a potentially effective preventive intervention for ISD, thereby ensuring that preventive intervention rests on sound conceptual and empirical foundations.

Infant sleep disturbance is a common problem. It is a set of commonly reported behaviours that occur in infants. Infants may wake up regularly during the night, take a long time to fall asleep (sleep-onset delay) and/or present other problems that are not acceptable to the parents, such as sharing their parents' bed (co-sleeping) (France, 1994). Sleep disturbance has been shown to persist throughout infancy and beyond into childhood (Jenkins, Bax & Hart, 1980; Kataria, Swanson & Trevathan, 1987; Pollock, 1994; Wolke, Meyer, Ohrt & Riegel, 1994; Zuckerman, Stevenson & Bailey, 1987).

While intervention for established ISD is successful, it may be stressful for both the parents and the infant. Several behavioural interventions for ISD have been empirically validated as successful (e.g., Durand & Mindell, 1990; France, Blampied & Wilkinson, 1991; France & Hudson, 1990; Lawton, France & Blampied, 1991; Reid, Walter & O'Leary, 1999; Sadeh, 1996). Despite this however, intervention programmes may be distressing for the parents as they frequently include a certain amount of infant crying (France, 1994), which can lead to parental non-adherence (France & Hudson, 1993), and a consequent exacerbation of sleep problem side effects which can include conditioned vomiting and fear of the cot (France, Henderson & Hudson, 1996).

Prevention is a better alternative to management of the problem once it develops, and should be one of the ultimate aims of family intervention research. To date, previous preventive studies have presented inconclusive outcomes regarding the efficacy of prevention for primary ISD. There is wide variation in the ages at which intervention was implemented, the degree of exposure to intervention, and timing of outcome measures. The literature on preventive intervention so far is incomplete.

The first section of this thesis is devoted to reviewing the literature on infant sleep using some criteria suggested by Mrazek and Haggerty (1994), considered by the author to be relevant for planning prevention for ISD. These were: defining ISD and the population to be targeted for intervention; providing evidence that the target population is at risk of the disorder; providing evidence of risk factors and their role in the development of the disorder; consideration of prior preventive intervention; describing the developmental task which prevention should be based on, and identifying a sound theoretical model to inform prevention.

The chapter organisation mirrors these criteria with Chapter One examining how the literature has defined and measured ISD, and in doing so, describing the target population. Chapter Two reviews the literature to examine the prevalence and continuity of ISD at separate ages across infancy. This also provides a benchmark against which the success of preventive intervention can be assessed.

In Chapter Three the literature on the risk and protective factors associated with ISD is examined to identify any parent and/or infant risk factors shown to precede and predict ISD. Chapter Four draws on the management literature in order to clarify the underlying mechanisms of proximal parent and infant factors, and their role in the development of ISD. In Chapter Five the previous prevention studies are reviewed in order to establish their efficacy and how they have informed the literature on prevention for ISD. Chapter Six examines evidence of the progressive steps infant take, both physiologically and behaviourally, in sleeping through the night, as this informs the timing of prevention. Chapter Seven addresses the criterion that preventive intervention must be supported by explanatory models with sound conceptual and empirical foundations. A model is required that specifies the target group, the timing of intervention, and the factors to be altered for intervention (Coie et al., 2000). The developmental models of ISD are reviewed in Chapter Seven. This is followed by a discussion of the rationale and aims in Chapter Eight.

In light of the literature review, the question "How do we best conduct primary prevention of ISD?" arises. This is because two crucial criteria for prevention have not been met: (i) the identification of an optimal time, developmentally, for prevention, and (ii) the parent and infant factors occurring in temporal proximity that precede and are predictive of ISD.

In the second section, the results of two studies designed to address these questions are presented. Chapter Nine describes the method common to both studies. Chapter Ten presents the results of a longitudinal study investigating the development norms for sleeping through the night over the first year of life. It also describes development of the longest uninterrupted sleep period (LUSP), and the distribution of Sleep Behaviour Scores (SBS) (Richman, 1981; Richman, Douglas, Hunt, Landsdown & Levere, 1985) in the first 12 months. Chapter Eleven examines how to intervene for prevention. Infant and parent behaviours presented in a developmental model (France & Blampied, 1999), which are implicated in the development of ISD, are examined to establish whether they precede, and predict, the emergence of ISD at 6 and 12 months of age. Chapter Twelve discusses these results with reference to how the gaps in the research have been completed. Implications for how the research informs developmental theory for ISD, and the practical implications for the prevention of infant sleep disturbance are also discussed.

PART ONE:

LITERATURE REVIEW

CHAPTER ONE

INFANT SLEEP DISTURBANCE

In order to develop a framework for primary preventive interventions the disorder that is to be targeted for prevention must first be operationally defined, and the target population described (Mzarek & Haggerty, 1994). In light of this necessary criterion, this chapter aims to describe the terminology, definitions and measurement employed in the literature on infant sleep. By addressing these aims the target group for prevention is also described.

This thesis considers common sleep disturbances in typically developing infants. It does not consider pathological or physiological sleep disorders such as parasomnias, fear-related sleep disorders, or infants with physical problems or developmental delay.

1.1. TERMINOLOGY, DEFINITIONS AND CRITERIA

1.1.1. Terms Used in the Study of Infant Sleep

According to France (1989) terms used frequently in the literature should be adhered to in order to facilitate comparison and communication. This research was conducted as one of the phases of research within the Canterbury (New Zealand) Sleep Programme (CSP), and it has followed on from France's work. It will therefore adhere to the terms used by the CSP. In this chapter the terms used by the CSP in the study of infant sleep are presented and described, and compared to other terms in the literature. This is necessary as several of the key concepts and terms have been defined differently by investigators in the field, and may be considered very differently by different cultures.

The sections are organised into three categories. Firstly, a clearly defined and justified operational definition of infancy is described. Secondly, a definition of ISD and its components is given. Thirdly, how the research has measured infant sleep, together with a suggested hierarchy of the measures is presented.

Where necessary, inconsistencies between CSP definitions and those of the American Sleep Disorders Association, the International Classification of Sleep Disorders Diagnostic and Coding Manual, ISDC, (1990 in Anders, 1997), the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, American Psychiatric Association, 1994) and of other key writers in the field will be noted and explained.

1.1.2. Definition of the Target Group: Infancy and Preventive Level

1.1.2.1. Definition of Infancy

In this study, the target group comprises infants, and infancy is defined as occurring from birth to the age of 24 months. This definition differs from that previously employed by the CSP where infancy was first defined from 6 months for the purpose of management intervention.

The reasons this study defines infancy as from birth until 2 years are:

1. In order to study the development of infant sleep patterns, sleep behaviours need to be measured from birth.
2. The upper age limit of 2 years will be employed for the same reasons as it was in previous CSP studies. After the age of 2 years sleep organisation more approximates that of adults; and because of the onset of language acquisition, management techniques for children over the age of 2 years requires separate consideration (France, 1989).
3. On the whole other contemporary literature has also employed the same period (0 - 24 months) as the present study to define infancy (e.g., Messer & Richards, 1993; Mindell, 1993; Wolke, Meyer, Ohrt, & Reigel, 1995a). A few researchers have used different definitions, namely Anders and Eiben (1997), who used 1 to 3 years, Zeanah (1997), for "roughly" the first 3 years of life, and Scher, Tirosh, Jaffe, Rubin, Sadeh and Lavie (1995), up to 12 months.

1.1.2.2. Definition of the Level of Prevention

The target group for prevention must also be described in terms of the level at which prevention is provided. Three levels of preventive intervention have been described by Coie et al. (2000). The first is primary prevention which emphasises the reduction of the incidence of onset of the disorder. The second, is secondary prevention which concerns intervention with individuals experiencing early signs of the disorder, and before it has fully developed. Tertiary prevention focuses on the prevention of further disability (Coie et al., 2000).

The focus of this thesis is to provide a framework for primary preventive intervention of infant sleep disturbance in order to reduce the incidence in onset. When primary prevention is to be provided can be further specified as prior to the age of 6 months as this is when ISD is first defined (see below).

1.1.3. Definitions of Sleep Disturbance in Infancy

As primary prevention aims to prevent ISD, it is necessary that the behaviours comprising ISD must be specified. According to the CSP, ISD is defined as a:

Group of commonly reported behaviours occurring in infants 6-24 months of age. Infants of this age may wake regularly during the night, take a long time to fall asleep (sleep-onset delay), and or present other problems that are not acceptable to their parents, such as sharing the parents' bed (co-sleeping).

(France, 1994, p. 101)

The last decade has seen this term "sleep disturbance" well established in the literature (Blampied & France, 1993; Carskadon, Anders & Hole, 1988; France 1989; France & Blampied, 1999; France et al., 1996; France & Hudson, 1993; Galbraith, Pritchard & Hewitt, 1993; Johnson & Lerner, 1985; Kataria et al., 1987; Kawasaki, Nugent, Miyashita, Miyahara & Brazelton, 1994; Owens, France & Wiggs, 1999; Pollock, 1994; Reid et al., 1999). Other terms which are synonymous with sleep disturbance have been: "Sleep problems" (Adair & Bauchner, 1993; Ashbaugh & Peck, 1998; Wolke et al., 1994), "sleep disorders" (Anders & Eiben, 1997; Ferber, 1996; Mindell, 1993; Sadeh & Anders, 1993; Stores, 1996), or a "regulatory problem" (Goodlin-Jones, Burnham & Anders, 2000; Keefe, Kotzer, Froese-Fretz & Curtin, 1996; Von Hofacker & Papousek, 1998; St James-Roberts & Plewis, 1996; St James-Roberts, Conroy & Wilsher, 1998).

There is some confusion in the literature about related definitions and terms. For example, Ferber (1996) provided separate and clear operational definitions for a sleep problem, and for a sleep disorder, yet subsumed both definitions under "sleep disorder". He argued that sleep disorder is used in common parlance, despite the fact that sleep disorder and sleep problem have different presentations and aetiologies. This research will not use Ferber's global use of the term sleep disorder. For the purpose of this research, the term "sleep disorder" will be employed to describe pathological functions of sleep, while "sleep problem" will remain synonymous with ISD.

1.1.4. Definitions of the Components of Infant Sleep

The behaviours used to describe ISD vary in their terminology, but are typically included under headings according to the stage of the sleep routine (France, 1989). The CSP definitions for the components of ISD are as follows:

1. Bed-time delay: Difficulty getting a child to bed. This has the advantage of being able to be quantified using a unit of time.

2. Sleep-onset delay or sleep latency: This is the amount of time from being placed in bed to sleep-onset also quantified as time.

3. Night waking: Within the context of ISD, night waking refers to awakenings, with calls/signals for (parental) attention, occurring at any time from the initial onset of sleep, to the time the child is removed from bed in the morning. The inclusion of signalling in this definition is essential because night waking is physiologically normal, and Time-Lapse Video Recordings (TLVR) have shown that infants typically awaken several times throughout the night (Anders, 1979). These awakenings may be brief and not detected by parents, with the infant resuming sleep unassisted. "Problematic" night awakenings are therefore defined by the infant's inability to fall asleep after awakening, with resumption of sleep contingent on a parental response. Night awakenings per se, are not the problem, rather the problem is that of sleep re-initiation following an awakening (Ferber, 1985). The most useful way of looking at this aspect of infant sleep is that the parental attention becomes a discriminative stimulus for the resumption of sleep (Blampied & France, 1993; France, 1989).

4. Co-sleeping: In order to be defined as a sleep problem co-sleeping needs to be a part of the behaviour chain employed to assist in resumption of sleep rather than based on parental beliefs about nurturing, or on cultural practice (Blampied & France, 1993). Co-sleeping is also defined as problematic when parents find it to be problematic. It refers to whether an infant is brought into the parental bed as: (i) a management intervention to assist the infant resume sleep following a night awakening; or (ii) an antecedent strategy, in order to prevent a night awakening, or manage one more easily.

1.1.5. Criteria for ISD

There is no universal definition for ISD. Definitions differ depending on whether it is the parent, diagnostic manual's criteria, or the researchers who define it. The lack of specificity of definitions in the DSM-IV (American Psychiatric Association, 1994), and the ICSD (American Sleep Disorders Association, 1990, in Anders & Eiben, 1997) may be one probable reason for the numerous definitions employed by studies.

1.1.5.1. Lack of Congruence Between Parent and Researcher Definitions

Until parent and researcher use of the ISD terms is fully understood, they should be considered separately in order to avoid confusion.

ISD has been defined by researchers who typically employ some pre-determined criterion such as night awakening (e.g., Moore & Ucko, 1957; Osterholm,

2

Lindeke & Amidon, 1983; Richman, Stevenson & Graham, 1975; Scher, 1991; Wolke et al., 1994; Zuckerman et al., 1987). Researcher-defined criteria serve the purposes of establishing norms on infant sleep, and rates of prevalence at different ages. Furthermore, a researcher-defined criterion can be used diagnostically in a clinical setting, in that it assists in determining if in fact the presenting problem is ISD.

It is the parents not the infants, who complain of ISD. Parents are affected by it, and it is their complaints and perceptions which are evaluated (Ferber, 1995). Within individual studies and across different societies, incongruence between researcher definitions and parental definitions of ISD has been reported. In a British study, Scott and Richards (1988) found that 10% of the parents with 1-year-old infants who met the researcher's criterion for ISD, did not, find their infants sleep to be problematic. Similarly, in a German study, Wolke et al. (1994) found at 5 months, that 21.8% of the infants met the researcher's criterion for ISD, while only 13.8% of the parents reported "feeling burdened" by their infants' sleep. On the other hand, Werry and Carlielle (1983) reported that 43% of the New Zealand parents in their sample had sought help with their child's sleep disturbance, yet only 5% reported concern with their child's sleep. In a Korean study, Lee (1992) reported that in the Asian culture "bedtime struggles and night time crying are not apparent" (p. 328). Despite this claim, Lee reported that 16% of the mothers considered their infants "night-time" crying (i.e. when the infants were in bed between the period sleep-onset and time-up the next morning) to be a problem, thus indicating that cultural influences do not completely determine parent's perceptions of their infant's sleep.

1.1.5.2. Definitions of ISD According to Diagnostic Manuals

There are no operationally defined criteria for classifying sleep disorders in infants in the DSM-IV (APA, 1994). The nearest category, that of Primary Insomnia, is more appropriate for classifying sleep disorders in adults than in children (Anders & Eiben, 1997). The American Sleep Disorders Association (1997, in Anders & Eiben, 1997) provides a category that applies to ISD termed "extrinsic dyssomnias". These are dyssomnias which are dependent on external factors to produce and maintain a sleep disorder of initiating and/or maintaining sleep. Anders and Eiben describe a problem in that the criteria for dyssomnias are not well defined for infants, and may be better characterised as "protodyssomnias". Protodyssomnias are based on parent complaint (Goodlin-Jones et al., 2000), and are characterised by frequent night awakenings, and the inability to fall asleep (Anders & Eiben, 1997). They suggest this term because (i) the criteria for primary insomnias are unlikely to be met at this age; and (ii) it is unknown whether protodyssomnias will develop into dyssomnias in later childhood.

1.1.5.3. How Studies Statistically Define ISD

Night awakenings are the predominant behaviour which empirical studies have used to define ISD (Messer & Richards, 1993; Moore & Ucko, 1957; Osterholm et al., 1983; Pollock, 1994; Richman, 1984). This is because night awakenings are one of the most common complaints of parents (Carskadon et al., 1988; Fergusson, Shannon & Horwood, 1981), and also the most prominent regulatory problems for infants aged between 7 and 24 months who are referred for management intervention (Von Hofacker & Papousek, 1998). Within the literature studies have employed three basic strategies to empirically define ISD, these will be presented and described.

1. Categorical method: Researchers designate a minimum number of night awakenings as a criterion for ISD. The defining criteria, however, vary greatly, and include awakening: (i) at least once a week (Moore & Ucko, 1957), (ii) at least once per night (Zuckerman et al., 1987), (iii) 2 or more nights in any 5 days (Osterholm et al., 1983), (iv) 3 or more nights per week, (Richman et al., 1975), (v) 5 or more nights per week (Scher, 1991; Wolke et al., 1994), or (vi) 7 nights per week (Adair, Bauchner, Philipp, Levenson & Zuckerman, 1991).

3. Parental perception: Parents answer "yes" to items such as night waking is a current problem or wakes up regularly (Armstrong, Quinn & Dadds, 1994; Hewitt, Powell & Tait, 1989; Klackenberg, 1968; Scher et al., 1995; Scott & Richards, 1990). Alternatively researchers (Scher, 1991; Scher et al., 1995) determine if parents consider their infant to awaken regularly. The mean number of awakenings of the "wakers" (per night or week), is compared with the means of "non-wakers" (Scher, 1991; Scher et al., 1995).

Parental perception of ISD can, however be problematic. Researchers in the area have highlighted the problem that some parents may perceive a "normal" sleep pattern as a problem, while other parents may not perceive a sleep problem in a child with a very disturbed sleep pattern (Carskadon et al., 1988; Ferber, 1996; Reid et al., 1999; Scott & Richards, 1990). Clearly then when considering parent/researcher definitions of ISD, distinctions should be kept in mind when the definitions are encountered.

4. Calculation of a composite score, where the score indicates the severity in sleep disturbance. These diagnostic tools include the Sleep Behaviour Score (SBS) (Richman, 1981, Richman, Douglas, Hunt, Landsdown & Levere, 1985), the Cumulative Sleep Score (Kerr, Jowett & Smith, 1996), and the Infant Sleep Questionnaire (ISQ, Morrell, 1999). Typically an infant will be defined as sleep-disturbed if the composite score is above the study's predetermined cut off score. The higher the score the more sleep disturbance.

Unfortunately for the field of infant sleep, the wide diversity of criteria used to define ISD only creates confusion in studying an already complex phenomenon. Several studies have employed the same criteria to define ISD from as early as 3 months of age through to 56 months of age (Klackenberg, 1968; Michelsson, Rinne & Paajanen, 1990; Scher, 1991; Wolke et al., 1994). As a number of major developmental changes occur in infant sleep patterns over this period, it is questionable how developmentally appropriate it is to employ the same criteria across these ages. One of the biggest challenges is to develop a consensus about a developmentally appropriate definition of ISD.

1.1.6. Age ISD is Defined in the Management Literature and Normative Studies

In order to measure the efficacy of preventive intervention, the age at which optimal outcome measures are collected must reflect the efficacy of primary prevention. One way of addressing when ISD is first defined is by establishing the age at which researchers have defined ISD, and the reasons for this.

Ferber (1996) addresses the issue of when ISD should first be defined. He states that what is normal at each age is determined by what is "technically" normal for that age and queried where the line should be drawn. Ferber questions whether it is normal for an infant to require intervention if awakenings happen weekly, more than once a night or every two hours at 3, 6 or 12 months, or at 3 years. There are obvious problems in determining what is technically "normal", such as: (i) whether the researcher's definition of ISD meets the parents' definitions of ISD; or, (ii) whether normative development mirrors parental and researcher expectations; and, (iii) whether prevalence research is based on sound methodology.

The problems of deciding what is technically "normal" was illustrated by Ferber (1996) using the findings of Moore and Ucko's (1957) early normative study. Moore and Ucko reported an increase in night awakening in the second half of the first year because 60% of infants at the age of 9 months were "sleeping through the night" and 40% were not. On the basis of their findings, Moore and Ucko claim that not sleeping through is "normal" behaviour at 9 months of age. Ferber pointed out that while this may be technically "normal", it does not mean that parents should be told to wait until the "child grows out it". If a 9-month-old's night awakening is a problem for the parents, despite it being "normal" at this age, then intervention could still be employed to solve the problem.

The age at onset of ISD has been defined by the management literature, and also by normative studies as:

1. Management intervention: ISD is typically first defined in the management intervention literature at 6 months (Edwards & Christophersen, 1994; France, 1989;

France et al., 1996; France & Hudson, 1990; Rickert & Johnson, 1988; Schmitt, 1981). This is for the following reasons: (i) prior to this age night awakenings are universal (France, 1989); (ii) prior to this age the nutritional needs of the child need to be met by night feeding; (iii) after the ages of 5 and 6 months healthy infants do not require night feedings and should be able to sleep through the night without waking to be fed (Ferber, 1995; Schmitt, 1981); (iv) by 6 months infants have the potential to be sound and excellent sleepers (Ferber, 1995); and, (v) research has shown the majority of infants are sleeping through the night by 6 months (Moore & Ucko, 1957). Messer and Richards (1993) claim that by 6 months of age parents should become concerned if the infant is awakening several times during the night, if putting the child to bed is an unpleasant struggle, or if parents are concerned that the child does not consistently sleep through the night.

Therefore, infant's who have never settled and slept through the night prior to 6 months of age are described as experiencing primary sleep disturbance (France & Blampied, 1999). While, secondary sleep disturbance occurs after an infant has had a clearly defined period of sleeping through the night without awakening (France et al., 1996).

Three management studies have provided treatment for ISD in infants younger than 6 months of age. Largo and Hunziker (1984) provided treatment for a 2-month-old infant, MacGarr and Hovell (1980) for a 3-month-old infant, and Weir and Dinnick (1988) included 4-month-old infants in their intervention programme.

2. Normative studies have defined ISD in infants less than 6 months. It has been established beginning from 1 month (Armstrong et al., 1994; Moore & Ucko, 1957), from 3 months (Klackenberg, 1968; Scher et al., 1995; Scher, 1991), and 5 months (Wolke et al., 1994). The prevalence of the ISD at these ages is described in Chapter Two, but it ranges between 23% to 47% prior to 6 months.

3. Another way studies could establish when infant sleep patterns are problematic is by examining whether parents had deliberately intervened to improve the sleep pattern prior to 6 months of age. Such information would indicate parental dissatisfaction with their infant's sleep, and assist in establishing the ages, or a modal age, prior to 6 months when parents consider the sleep pattern to be problematic enough for treatment intervention.

1.2. MEASUREMENT OF INFANT SLEEP

Researchers investigating infant sleep disturbance measure it in a number of different ways. These are presented and described below.

1.2.1. Parent Report

Parental report is one of the earliest, and most common ways that studies considering infant sleep behaviour have measured it (Klackenberg, 1968; Moore & Ucko, 1957; Parmelee, Wenner & Schultz, 1964; Sadeh, 1996; Thoman & Acebo, 1995). This has been done in the following ways:

1. Questionnaires: Parents retrospectively recall their infant's sleep pattern. These may take the form of specially designed questionnaires on sleep (Lee, 1992; Richman, 1981; Sadler, 1994; Scher, 1991; Scher et al., 1995; Van Tassel, 1985), or are embedded in a general questionnaire regarding the infant's health and development (Armstrong et al., 1994).
2. Interviews: These are also retrospective. While the earliest longitudinal studies investigating the development of infant sleep employed this measure, (Klackenberg, 1968; Moore & Ucko, 1957; Traisman, Traisman & Gatti, 1966) they are still frequently employed (Wolke et al., 1994).
3. Sleep logs/Sleep charts/Sleep records: These provide a measure of the length and frequency of sleep periods. Typically they are prospective and presented on forms or charts with blocks designating between 15 to 60 minutes in 24 hour periods. Parents either code a letter or draw a line through the block to indicate if the infant is awake or asleep (Jacklin, Snow, Gahart & Maccoby, 1980; Michelsson et al., 1990; Osterholm et al., 1983; Parmelee et al., 1964; Sadeh, 1996; St James-Roberts & Plewis, 1996).
4. Daily diaries: While diaries record the same information as sleep logs/charts/record, what differentiates the diary is that additional specific parent and infant behaviours are recorded such as: time in bed, duration to sleep-onset, the frequency and duration of night awakenings, and the parental behaviours during sleep-onset and in response to night awakening (France, 1989; France & Hudson, 1990; Richman, 1981;1985; Minde, Popiel, Leos, Falkner, Parker & Handley-Derry, 1993; Wooding, Boyd & Geddis, 1990).

1.2.2. Methods Employing Direct Observation

The majority of studies that employ direct observation do so in order to investigate the physiological development of infant sleeping and waking states, these include:

1. Infra-red time-lapse video recording (TLVR): A direct behavioural observation in which video equipment and a microphone is brought into the home and placed by the infant's cot. The first to employ this method was Anders (1979) who recorded infant sleep/wake behaviour. In the last two decades this method has been increasingly used both to record infant sleep-state development (Anders, Halpern & Hua, 1992; Anders, Keener, Bowe & Shoaff, 1983; Halpern, Anders, Garcia Coll & Hua, 1994) and to check reliability of parent report (France & Blampied, 1999; Minde et al., 1993).
2. Actigraphic home monitoring (activity-based monitoring: Sadeh, Alster & Urbach et al., 1989; Sadeh, Acebo, Siefert, Aytur & Carskadon, 1995; Sadeh, Lavie, Scher, Tirosh & Epstein, 1991): An actigraph, is a small computerised movement detector weighing about 50 grams and is worn on the arm or leg of the child (Thoman & Acebo, 1995). It continuously registers limb movements which are then summed over 1 minute periods to determine density of movements. This correlates highly with Non REM, REM, and wake states.

1.2.3. Most Commonly Used Measures by Investigators

France (1989) concluded that the combination of diary and interview are the most common measures used by the studies. In contrast, questionnaires were the most common measures employed by recent studies, closely followed by interviews (see Table 1). This could be explained by the fact that when collecting data from large numbers of participants questionnaires are more cost effective and time efficient compared with one-to-one interview schedules.

1.2.4. Validity of Parent Report

TLVR and diary: Anders (1979) reported a high correlation between video records and parent daily diaries. Similar positive findings have been reported by France and Blampied (2001), and Minde et al. (1993) who reported a high correlation between TLVR and sleep-diary measures for intervention infants with ISD, and low correlations for control group infants.

1.2.5. Hierarchy of Measures

A hierarchy of approaches to measuring infant sleep, based on France's (1989) suggested hierarchy, is presented. The hierarchy begins with the most desirable

measure of direct recordings of infant and parent behaviours, to the least desirable of retrospective parent interviews. It is used because error increases with the distance from the behaviour measured (France, 1989). It allows examination of the validity and methodological rigor of specific studies whose findings have dominated the field. On the basis the majority of studies have employed parent report in their measures, I have amended France's hierarchy by: (i) differentiating between sleep log/charts and daily diaries, and (ii) including sleep questionnaires in the hierarchy, and (iii) specifying the differences in time specified interviews, and ranking these.

The most to the least desirable measures are:

1. Direct measurement of both infant and parental behaviour as employed by Anders (1979). Parents tend only to report those awakenings that they detect, while direct observation records all awakenings and provides a direct measure of these.
2. Prospective parental measures such as daily diaries. Prospective behavioural diaries have been widely adopted as the most cost-effective method of studying infant sleeping, fussing and crying (St James-Roberts & Plewis, 1996). For the purpose of describing the developments in infant sleep, and the "ecology of the night" (Anders et al., 1992), prospective daily diaries are more desirable to sleep logs/sleep charts/sleep records. Sleep diaries allow for a prospective record of the specific parental and infant behaviours that occur (e.g., France & Hudson, 1990; Wooding et al., 1990), while sleep logs only report the durations of periods of sleep and waking (Michelsson et al., 1990).
3. Sleep Questionnaires: Those completed closer in time to the behaviour (e.g., Adair et al., 1991) will have fewer errors than studies requesting parents to recall the preceding 2 weeks (e.g., Lee, 1992; Richman, 1981; Van Tassel, 1985), and studies that failed to specify the preceding time period over which parents were asked to recall their infant sleep patterns (e.g., Armstrong, et al., 1994; Sadler, 1994; Scher, 1991; Scher et al., 1995; Scott & Richards, 1990).
4. Time specified interviews: Data from parents recollections of the preceding time period is used, such as 2 weeks (Richman, 1981), 3 months (Moore & Ucko, 1957), 3 years (Fergusson et al., 1981), or 5 years (Pollock, 1992). It is unrealistic to expect mothers to accurately recall the specific sleep behaviours of their infants over such periods. Moore and Ucko for example, asked mothers to recall three months earlier if their infant had awakened every night, between the hours of midnight and 5:00 p.m. The accuracy of data collected by this method is highly questionable.

The rapid changes in infant sleep in the first 6 months of life demands that the period over which measures are collected, must be considered when establishing a hierarchy of measures. Reliance on single night measures may lead to erroneous conclusions (St James-Roberts & Plewis, 1996). These authors suggest that measures collected for more than one 24-hour period will lessen the variability, and perhaps demonstrate greater stability in the behaviour. They found from diaries completed for 1 to 3 days that day-to-day variability was the largest single source of variance in the amounts of sleeping, waking, fussing, and crying for infants between the ages of 2 to 40 weeks. For sleeping, crying and fussing, day-to-day fluctuations accounted for around a half of the overall variance in each area of behaviour. Such findings support the contention that single measurements are likely to be misleading, at least insofar as individual differences between infants are concerned. Barr and Desilets (1996) established four consecutive days of diary data to be the most cost-effective and reliable measure of individual differences in fussing and crying. Such a finding can be generalised to infant sleeping.

Daily diaries completed consecutively for longer than three days (France & Hudson, 1990; Wooding et al., 1990) are therefore more desirable than those completed for fewer days (e.g., Anders et al., 1983; Pinilla & Birch, 1993).

1.3. SUMMARY

1. There is no universal definition of ISD.
2. The frequency of night awakening is the predominant behavioural measure for defining ISD.
3. Empirical studies have employed three basic strategies to define ISD. These include, a categorical method, parental definitions, or the use of a composite scale-based score.
4. The different strategies for defining ISD have resulted in a wide diversity of criteria. These criteria, however, do not reflect the developmental changes in sleep patterns across infancy and early childhood, i.e., criteria employed to define ISD at 3 months continue to be employed at 56 months.
5. There are different methods to measure infant sleep. In earlier studies the most common measures were diary and interview, while questionnaires and interviews are the most common in recent research.
6. It is most desirable to directly measure both infant and parent behaviour. If this is not possible then prospective daily diaries are acceptable.
7. Because of the high variability in infant behaviours reliance on single measures may lead to erroneous conclusions. A minimum of three consecutive days of measures is necessary.

8. Intervention studies have generally defined ISD at 6 months.
9. Normative studies have defined ISD as starting earlier than this. Between 23% to 46% of infants from 3 to 6 months of age are defined as experiencing ISD.

1.4. CONCLUSION

Because this thesis addresses issues of preventive intervention the relevance of this section is clear. When planning any preventive intervention for ISD, then sleep disturbance must be conceptually and theoretically examined. In light of Mrazek and Haggerty's (1994) suggested criteria, ISD was operationally defined through description of the terms, criteria and measures, which in turn described the population targeted for intervention. Also described was how empirical studies employed different definitions and varying methods of measuring infant sleep. Because intervention for ISD does not typically begin until infants are 6 months of age, preventive intervention should begin prior to this age. Normative studies have reported that parents of very young infants find their sleep a problem. This suggests that preventive efforts may need to be targeted in early infancy. The next chapter addresses the likelihood of continuity in these sleep patterns.

Night awakening is the most common behaviour used to define ISD, and its behaviour is "sleeping through the night". This is a developmental task that the majority of infants achieve in their first year. The developmental progressions in sleeping through the night must be therefore be considered in the timing for preventive intervention of ISD.

CHAPTER TWO

THE PREVALENCE AND PERSISTENCE OF INFANT SLEEP DISTURBANCE

Mrazek and Haggerty (1994) suggested that good preventive interventions must present scientific evidence to demonstrate that the target group is actually at risk of the disorder or problem. This also assists in describing the characteristics of the target group. In the case of this thesis, it is necessary to demonstrate that infants are at risk of developing disturbed sleep such as sleep-onset delay, and/or frequent and/or prolonged night awakenings. The empirical literature is reviewed below in light of these criteria. The prevalence and persistence of ISD across different ages are presented to illustrate the "risk" of an infant presenting with ISD. This will also provide a benchmark against which the success of preventive intervention can be assessed.

There are two important reasons why the prevalence of ISD must be described at different age points across infancy, i.e., across the first 3 months, and from 3 months to 6 months, and so on. First, no empirical study or review has yet done this in an integrated manner where the components of ISD are considered separately. We therefore do not know the specific rates of key sleep variables, such as night awakenings and sleep-onset delay, at different ages. Identifying such developmental trends in ISD, whether these trends are linear, or not, and prodromal features of ISD would assist in identifying the optimum time to target prevention.

The aim of this chapter is to review the empirical studies to establish evidence of the prevalence and persistence of ISD over successive ages in infancy. This will include identifying the earliest ages at which key behaviours of ISD have been identified, and over what duration of time they persist. This would assist in determining whether, in fact, infants simply "grow out of the problem" of sleep disturbance (Wolke, et al., 1995a), or whether in fact it does persist.

2.1. THE PREVALENCE OF ISD

France (1989) comprehensively reviewed the prevalence of ISD and described rates of night waking as ranging between 20% and 37%. This rate is frequently cited in recent literature (e.g., Acebo & Thoman, 1995; Adair & Bauchner, 1993; Lee, 1992; Mindell, 1993; Reid et al., 1999; Scott & Richards, 1990; Stores, 1996; Van Tassel, 1985; Walters, 1993). France stated that rates reported outside of the range were

explicable as those studies used either very lax or very stringent criteria. She found that studies reporting the lowest rates tended to present data at only one age point (e.g., Anders, 1979; Bernal, 1973; Fergusson et al., 1981; Zuckerman et al., 1987; Richman, 1981; Richman et al., 1975), or employed a criteria of awakening 2 to 3 times per week (Jenkins et al., 1980).

Studies that considered the prevalence of ISD at different age points in the first 2 years are presented in Table 1. This review expands on France (1989) by reviewing contemporary studies (e.g., Adair et al., 1991; Armstrong et al., 1994; Michelsson et al., 1990; Scher, 1991; Scher et al., 1995; Scott & Richards, 1990), and including studies omitted by France (Hewitt et al., 1989; Osterholm et al., 1983). However, because so few studies could be located, data from some of the studies France reviewed are included in this review (i.e. Anders et al., 1979; Werry & Carlielle, 1983; Zuckerman et al., 1987) as they provide data at separate age points during infancy.

2.1.1. Night Waking

Table 1 demonstrates how few studies have reported sequential rates of ISD. The majority of studies employed night awakening as a criterion for ISD, with rates typically ranging between 20% and 40%. Studies considering the prevalence of night waking have variously reported this as: 23% to 46% of infants from 1 to 3 months of age, 29% to 31% of infants from 4 to 6 months of age, 23% to 38% of infants from 7 to 12 months of age, and 19% to 32% of infants from 13 to 24 months of age.

The rates presented for separate ages are comparable to the overall rate cited by France (1989). The rates are remarkably consistent, regardless of whether criteria were maternal complaint or researcher defined. There was a narrow range in the number of nights an infant had to awaken for researchers to define ISD. They ranged from 4 to 7 nights of the week. As France (1989) found, the results outside of these ranges are explicable when considering the criteria employed. The lowest rates were in studies reporting rates at only one age (Zuckerman et al., 1987), or those that employed stringent criterion of waking 3 times per night (Zuckerman et al., 1987). The highest rates were in studies that aggregated data to include a wide range of ages (Michelsson et al., 1990; Osterholm et al., 1983; Scher, 1991; Scher et al., 1995).

2.1.2. Sleep-Onset Delay and Bed-Time Delay

The figures reported for these components were generally low, and few studies provided data. From 6 to 24 months the figures reported ranged between 5% and 33% (Hewitt et al., 1989; Scott & Richards, 1990; Werry & Carlielle, 1982).

Table 1.
The prevalence of infant sleep disturbance

AUTHOR	N	SOURCE	MEASURE/ DESIGN	CRITERIA	AGE (MO)	% MEETING CRITERIA	
						NIGHT WAKE	ONSET
Adair, Bauchner, Philipp, Levenson & Zuckerman (1991)	122	Clinic Well Child Visit	Quest'are Cross'l ¹	> 7 per week	9	28	
Anders (1979)	32	Birth Column	Time-lapse video Cross'l	>1 wake per night midnight - 5:00 a.m.	9	25	
Armstrong, Quinn & Dadds (1994)	3269	Child Health Centres	Quest'are Cross'l	Child's sleep pattern a significant problem	<1	27	
					1-3	23	
					4-6	27	
					7-9	36	
					10-12	36	
					13-18	28	
					19-24	32	
Carey (1980)	60	Private Medical Practice	Maternal Quest'are	Waking >4 nights per week midnight - 5:00 a. m. for 4 weeks	6-12	15	
Hewitt, Powell & Tait (1989)			Survey	Night waking 1. sometimes 2. frequently	9	31 12	33
Klackenberg (1968)	212	Existing study	Interview Long'l ²	Maternal complaint about night waking	3	34	
					9	24	
					18	19	
Michelsson, Rinne & Paajanen (1990)	78	Well Baby Clinics	Diary 2 nights Cross'l	Not sleeping for 8 hours 11:00 p.m.- 6:00 a.m.	3-8	66	
	43				>9	<50	

Table 1. continued

AUTHOR	N	SOURCE	MEASURE/ DESIGN	CRITERIA	AGE (MO)	% MEETING CRITERIA		
						NIGHT WAKE	ONSET	
Osterholm, Lindeke & Amidon (1983)	80	Primary Care Clinics	Quest'are Sleep record 5 days Cross'l	Waking >2 nights per week midnight - 5:00 a.m. Parent report of problem	6-12			
						44		
						22		
Scher (1991)	118	Maternity Ward	Quest'are Long'l	Regular "night- waker"	3	46		
					6	39		
					9	58		
					12	55		
Scher, Tirosh, Jaffe, Rubin, Sadeh & Lavie (1995)	661	Well Baby Clinics	Quest'are Cross'l	Night waking "wake up regularly"	4-24	32		
Scott & Richards (1990)	1500	Six English Health Districts	Quest'are	Night waking 1. mild 2. mod/severe	12	1. 33 2. 26	15	
Werry & Carlielle (1982)	196	Utility Customer List	Interview Cross'l	Night waking >1 per week >3 per week		>1	>3	
					3-5	0	22	0
					6-11	5	45	5
					12-17	6	25	6
					18-23	21	26	21
Wolke, Meyer, Ohrt & Reigel (1994)	432	Maternity Hospitals	Interview Long'l	Night waking at least once 5 or more times a week	5	22		
					20	22		
					56	13		
Zuckerman, Stevenson & Bailey (1987)	308	General Practices	Interview Cross'l	Night waking >3 per night >1 hour to settle	8	10		
						8		

Note. ¹ Cross'l abbreviation for Cross-sectional, ² Long'l abbreviation for Longitudinal

2.2. THE PERSISTENCE OF ISD

There is some evidence of the continuity or persistence of sleep disturbance throughout infancy and beyond into childhood. France (1989) concluded from her review of longitudinal studies that followed children with ISD, that later rates of ISD were equal to, or greater than when the children were younger. Her main critique was that the majority of studies did not report the rates for the same children at different ages. She cited two studies that were exceptions to this rule. In the first study, Kataria et al. (1987) identified a sleep-disturbed group at the first interview, and found that 84% of these infants were still sleep-disturbed at 3 years. In the second study, Zuckerman et al., (1987) found that of 308 children, 56 infants were sleep-disturbed at 8 months, and 41% of these 56 were still sleep-disturbed at 3 years.

Recent studies also continue to demonstrate persistence of ISD. In a Bavarian prospective longitudinal study, Wolke et al. (1994) reported a significant continuity of night waking problems in infants. There was a 1.4 fold risk of remaining a night waker from the ages of 5 to 20 months, and from 20 to 56 months. The infants who were night wakers were 1.7 to 2.2 times more likely to continue night waking, compared with infants who did not awaken. Pollock (1992) asked mothers of 5-year-old children to retrospectively recall their infants' sleep patterns when they were 6 months of age. He noted that from 6 months to 5 years night wakers were 3 times more likely to remain night wakers, compared to infants who did not wake to become night wakers. This is a high rate of continuity and could possibly be explained by the long period of maternal recall.

Despite the above evidence that ISD does persist beyond the period of infancy through at least until the middle childhood years, Wolke et al. (1995a) argues that most night wakers will grow out of sleep disturbance and will start sleeping through the night. While some infants' sleep patterns may improve over time, it is possible that parents of some infants in normative studies may have successfully intervened in an attempt to change their infant's sleep pattern. Without such data it is difficult to establish exactly the persistence of ISD, and/or the rates of "spontaneous" improvement in infant sleep patterns.

2.3. METHODOLOGICAL DRAWBACKS OF PREVALENCE AND PERSISTENCE STUDIES

The methodological drawbacks of the published studies make it difficult to synthesise the empirical findings into a coherent conclusion. The reasons are described below.

2.3.1. Samples Used

Similar to France's (1989) findings, the studies in this review also demonstrated a fairly representative sample of infants in this area of research. The main source of samples for the majority of cross sectional studies were from Well-Baby Clinics (U.K. Israel, Korea, U.S.A.), and their equivalents such as Plunket (N.Z.) and Child Health Centres (Australia). The majority of the studies' samples comprised infants from Western countries. No studies could be located that reported rates from indigenous cultures such as Indian, Aboriginal or Maori. While some of the studies (e.g., Scher, 1991; Scher et al., 1995) report the percentage of participants from different cultures they were not separately reported in further analysis.

2.3.2. Lack of Direct Measures

Over a decade ago, studies were criticised for not employing prospective and direct measures (France, 1989). Unfortunately, the same criticisms apply to more recent studies.

Few authors attempted to justify these failings, and those that did (e.g., Scott & Richards, 1990), cited the high agreement between sleep diaries and direct measures reported by Anders (1979). Similarly, Armstrong et al. (1994) justified not employing independent validation of parental report in their questionnaires, because, they claimed that parental report of children's behaviour is quite accurate. This is based on the findings of a study which employed diaries to measure infant fussing and crying behaviour. Furthermore, the justification used by Werry and Carlielle (1983) was that Moore and Ucko (1957) reported a high correlation between diary records as a validity check against retrospective interview data. However, Moore and Ucko reported that only 28% of their sample completed daily records as a validity check. Moore and Ucko did not, however, report any data to demonstrate the degree of relationship between the two measures.

2.3.3. Hierarchy of Measures

The majority of studies employed measures at the "low" end of the hierarchy by employing either a questionnaire or interview. Few studies reported the time period over which parents were asked to recall their infant's sleep patterns.

2.3.4. Diversity in Definitions and Strategies

As shown in Table 1, there is a wide diversity of definitions employed by studies of ISD, especially for the night waking component.

From her review, France (1989) noted a lack of consistent definitions in the studies. This criticism still remains for more recent studies. One study even neglected to provide a definition of night waking (Werry & Carlielle, 1982). Some studies

provided nebulous definitions of ISD such as "maternal complaint" (Armstrong et al., 1994; Klackenberg, 1968), or if the infant woke "occasionally or frequently" (Hewitt et al., 1989) or "regularly" (Scher, 1991; Scher et al., 1995). These definitions do not provide any indication of the frequency, either per night or week, that infants are awakening. Other studies used more rigid definitions for night awakening, where a criterion for number of awakenings was determined, and/or specified periods were defined as night-time (Adair et al., 1991; Michelsson et al., 1990; Osterholm et al., 1983; Scott & Richards, 1990; Wolke et al., 1994).

2.3.5. Lack of Data for Specific Age Points

One of the main concerns about prevalence studies is that by aggregating data over a number of ages, researchers remove information regarding developmental changes. Some cross-sectional and longitudinal studies collected data at a number of age points, but aggregated data over wide age ranges, such as 3 to 8 months (Michelsson et al., 1990), 4 to 24 months (Scher et al., 1995), 6 to 12 months (Osterholm et al., 1983), and 6 to 11 months (Werry & Carlielle, 1982). Armstrong et al. (1994) had a large sample size, but presented single data points for groups of infants including three different ages. A main aim of these studies was to investigate age-related changes in night awakening. By aggregating data (Armstrong et al., 1994; Michelsson et al., 1990; Osterholm et al., 1983; Scher et al., 1995) the analysis of age-related changes is prevented. In addition, it is difficult to compare these findings with studies that report data at successive age points (e.g., Scher, 1991; Wolke et al., 1994).

2.4. SUMMARY

1. Over a decade ago, France (1989) concluded from her review of the literature that between 20% and 30% of infants experienced ISD.
2. Few recent prevalence studies have been published.
3. Comparison of studies is difficult. There was a wide diversity in the criteria for defining ISD. These ranged from maternal complaint to criteria based on number of night awakenings.
4. Cross sectional and longitudinal studies fail to give data for specific ages. This makes it difficult to investigate age-related differences in prevalence.
5. More recent studies continue to repeat the methodological problems of previous studies.
6. The range of ISD across ages generally falls within that reported by France (1989).
7. Nine months is the most common individual age for studies reporting a rate of ISD. Only three studies reported rates at various individual age points in the first 12

months. This suggests there can be little confidence regarding a benchmark against which to measure ISD at separate ages.

8. It is difficult to establish rates of ISD across different ages. The results of studies that aggregated data cannot be directly compared with those studies presenting data for separate ages.
9. It is difficult to directly compare studies. Variation in rates reflects variation in studies' measurement designs. This limits a consensus on the rates of ISD at different points in infancy,
10. Infants who were night wakers have a 1.4 to 3 fold risk of remaining a night waker at a later age.

2.5. CONCLUSION

The aim of this chapter was to establish the rates of ISD at different age points during infancy but this was not possible. This is unfortunate because establishing these rates of ISD would make it possible to identify developmental trends and the optimum time for preventive intervention. It would also provide a benchmark against which the success of preventive intervention can be assessed. Further normative research that employs prospective measures across separate consecutive ages during infancy is therefore necessary.

CHAPTER THREE

RISK AND PROTECTIVE FACTORS ASSOCIATED WITH INFANT SLEEP DISTURBANCE

A criterion that Mrazek and Haggerty (1994) consider as most critical in evaluating preventive intervention, is the accumulation of data on well documented malleable, or modifiable, risk factors. Defining this criterion must be considered in the planning of prevention because it is crucial to the success of prevention efforts. It is this data that informs the content of preventive intervention (Coie, et al. 2000).

Examining factors that have been associated with ISD is one way of identifying their risk status. In order for a risk factor to be valid, it must not only demonstrate an association with ISD, but be shown to precede and be predictive of ISD. These latter criteria assist in establishing the causal status of the risk factor.

There have been two approaches used to describe risk factors associated with ISD. The first approach has been to examine empirical studies that have investigated the association of ISD and various factors. The relevant literature from the past two decades is, however, difficult to describe and integrate. Several authors have attributed this to a lack of clear direction, and the generally poor quality of, and lack of theoretical attempts at, explaining infant sleep disturbance (Anders & Eiben, 1997; Ferber, 1987; France, 1989; France & Blampied, 1999; Messer & Richards, 1993; Sadeh & Anders, 1993; Sostek & Anders, 1981).

A second approach described by France (1989), is to tie the literature on associated factors together in a coherent manner through the use of thorough theoretical explanations. The last decade has seen progress in this approach with the publication of explanatory models of infant sleep development which are grounded in both empirical research and coherent thought. These models are described in Chapter Seven. By reviewing the literature from both of these approaches it may be possible to identify the risk factors associated with ISD, and their relative causal status.

This chapter aims to review studies using the first approach; identification of risk factors. Despite the difficulties of integrating and describing the literature on factors associated with ISD, it has been previously well reviewed. Up until 1989, the published empirical literature was extensively, and comprehensively reviewed, by Ferber (1987), France (1989), and Messer and Richards (1993). Messer and Richards stopped their review at 1989. These reviews have been updated recently (e.g., Adair & Bauchner, 1993; France & Blampied, 1999; Kerr & Jowett, 1994; Sadeh & Anders, 1993; Wolfson, 1996). These latter reviews were, however not as extensive, and the

reviewers described fewer factors implicated with ISD than the earlier reviews. This may reflect the fact that earlier reviews helped to refine subsequent authors' perceptions of which factors do influence the development of sleep-wake patterns in infants.

The general conclusion of the reviewers has been fairly consistent. On the one hand this is surprising, given the different theoretical perspectives in the field, and the early reviews described numerous studies which had relatively unsophisticated methodology. On the other, it is not, given that the latter reviews were conducted only 4 to 5 years later, and that fewer studies had been published during this intervening period.

This review will update the extensive findings presented by France (1989). The studies France reviewed will not be cited, rather, her findings will be summarised according to their support of, or lack of, an association between particular factors and ISD. Then findings from empirical studies published since 1989, together with earlier studies omitted from France's review, will be presented.

In this chapter, the individual characteristics of infants and parents, and different practices around sleep will be summarised. These are two of three areas that have been identified by recent reviews as having the greatest number of factors associated with ISD. The third area is that of physiological factors, and is covered in Chapter Six. The findings generally fall into three categories. These are factors that have: (i) a weak, or inconclusive association with ISD; (ii) a strong association with ISD; and, (iii) an association with settled sleep patterns. Where possible the directional influence of factors with a strong association with ISD will be described. Evidence that a factor precedes a disorder (in this case ISD), is an important indicator that it may have at least a potential role in causation (Mrazek & Haggerty, 1994).

3.1. FACTORS WITH A "WEAK" OR "INCONCLUSIVE" ASSOCIATION

The results of studies which investigated these variables are summarised in Table 2.

3.1.1. Individual Characteristics of the Infant

3.1.1.1. Birth Order

The majority of studies reviewed by France (1989) found an association between being first-born and demonstrating sleep disturbance. This finding has not been supported by other research (Crowell, Keener, Ginsburg & Anders, 1987; Jimmerson, 1991; Lehtonen, Korhonen & Korvenranta, 1994; Pollock, 1992). Two studies reviewed by Messer and Richards (1993) employed objective measures of

Table 2.
Infant characteristics associated with infant sleep disturbance

AUTHOR	COLIC/ CRYING	TEMPER- AMENT	ILLNESS	BIRTH ORDER	SEX	TOTAL SLEEP	LUSP	SELF- SOOTHE	PREM- ATURITY
Anders & Keener (1985)									No association
Anders, Halpern & Hua (1992)								Negative association	
Atkinson, Vetere & Grayson (1995)		Positive association			No association				
Crowell et al. (1987)				No association	No association				
Halpern, Anders, Garcia Coll & Hua (1994)		Positive association							
Ghaem, Armstrong, Trocki, Cleghorn, Patrick & Shepherd (1998)			Positive association						
Jimmerson (1991)		Positive association		No association	No association				
Kahn, Rebuffat, Scottiaux, Dufour, Cadranet & Reiterer (1991)			Positive association						

Table 2. *continued*

AUTHOR	COLIC/ CRYING	TEMPERAM ENT	ILLNESS	BIRTH ORDER	SEX	TOTAL SLEEP	LUSP	SELF- SOOTHE	PREM- ATURITY
Kahn, Mozin, Rebuffat, Scottiaux & Muller (1989)			Positive association			Positive association			
Keefe, Kotzer, Froese-Fretz & Curtin (1996)	Positive association					Positive association			
Keener, Zeanah & Anders (1988)		Positive association				Positive association	Positive association		
Lehtonen, Korhonen & Korvenranta (1994)	No association			No association	No association				
Minde, Popiel, Leos, Falkner, Parker & Handley-Derry (1993)	Positive association	Positive association							
Osterholm, Lindeke & Amidon (1983)					No association				
Papousek & Von Hofacker ¹ (1995)	Positive association			No association	No association	Positive association			
Pollock (1992)				No association					

Table 2. *continued*

AUTHOR	COLIC/ CRYING	TEMPERAM ENT	ILLNESS	BIRTH ORDER	SEX	TOTAL SLEEP	LUSP	SELF- SOOTHE	PREM- ATURITY
Scher, Epstein, Sadeh, Tirosh & Lavie (1992)		Positive association							
Scott & Richards (1990)					No association				
St James-Roberts, Conroy & Hurry (1996)	Positive association					Negative association			
Tirosh, Scher, Sadeh, Jaffe & Lavie (1993)			No association			No association			
Tirosh, Scher, Sadeh, Jaffe, Rubin & Lavie (1993)			No association	No association					
Weissbluth (1981)		Positive association							
Weissbluth, Davis & Poncher (1984)	Positive association				No association	Positive association			No association
Wolke et al. (1995a)									
Wooding, Boyd & Geddis (1990)				Negative association					

Note. ¹clinically referred infants vs. controls

sleep yet failed to find any association (Anders et al., 1985; Thoman & Whitney, 1989). Messer and Richards concluded that differences due to birth order are more likely to be attributed to the parents' behaviour, and their attitudes to ISD. Pollock suggested that first born children do not necessarily have more sleep problems. Rather, parents with their first child tend to seek more information about and help with night waking.

3.1.1.2. Gender

France (1989), and Messer and Richards (1993) both reported a lack of association between gender and ISD as did studies in the present review (Crowell et al., 1987; Jimmerson, 1991; Osterholm et al., 1983; Scott & Richards, 1990). In contrast, Scher et al. (1995) found that more females than males aged from 4 months to 4 years were described by their mothers as "regular awakeners".

3.1.1.3. Heritability

Research in the area of ISD and genetics is sparse (Messer & Richards, 1993), and has been poorly investigated (France, 1989). France found no studies that supported an association between genetics and ISD. Messer and Richards cited two studies where sleep problems had reoccurred within the same family (Scott & Richards, 1990; Richman, 1981). Such findings can not be attributed to genetic influence given the influence of environmental, and in particular, parenting variables.

3.1.1.5. Perinatal Events

Studies investigating this factor have presented controversial findings and France (1989) concluded that the relationship remains unclear. Messer and Richards (1993) however, reported an association between perinatal factors and ISD (although they reviewed fewer studies than France). Analysis of these two reviews shows that four studies reported an association (Bernal, 1973; Blurton-Jones, Rossetti-Ferrerira, Farquar-Brown & MacDonald, 1978; Moore & Ucko, 1957; Richman, 1981), while four studies did not (Campbell, 1981; Chavin & Tinson, 1980; Fergusson et al., 1981; Van Tassel, 1985). Further, the association reported by Bernal may be misleading given that the perinatal factors reported in this study were within the normal limits for uncomplicated deliveries (Messer & Richards, 1990).

3.1.1.6. Prematurity

The evidence suggests there is little obvious association between prematurity and sleep disturbance. Wolke et al. (1995a) investigated differences in the sleep patterns of premature and full-term infants. At 5 months of age pre-term infants settled more quickly and had fewer and shorter night awakenings compared with full-

Table 3.
Environmental and parental factors associated with infant sleep disturbance

AUTHORS	SES	AGE	MATERNAL INSECURE ATTACHMENT	1. EMPLOYMENT 2. EDUCATION	MOTHER DEPRESSION /MALAISE	FAMILY/ MARITAL STRESS	MATERNAL PRE-NATAL SLEEP DISTURBANCE
Adair, Bauchner, Phillip, Levenson & Zuckerman (1991)		No association		2. No association			
Armstrong, O'Donnell, McCallum & Dadds (1998)	No association	No association		2. No association	Positive association		Positive association
Armstrong, Van Haeringen, Dadds & Cash (1998b)					Positive association		
Benoit, Zeanah, Boucher & Minde (1992)	No association	No association	Positive association	2. No association		No association	
Jimmerson (1991)	No association	No association		No association 1 or 2		All mothers reported disruption in family functioning	
Minde, Popiel, Leos, Falkner, Parker & Handley-Derry (1993)	No association	No association			No association		
Scher et al (1995)	No association	No association	No association	1. Positive association			
Scott & Richards (1990)	No association	Positive association		1. No association	Positive association	Positive association	

Note. No study differentiated marital status, whether single parent or in a partnership

term infants. These differences were not found between the groups at 20 and 56 months. Wolke et al. (1995a) concluded that care-taking behaviour is more important in the development of ISD than prematurity or neurological immaturity. Anders et al. (1983), and Anders and Keener (1985) employed objective measures and found little difference between the sleep patterns of premature and full-term infants.

3.1.2. Family Composition and Characteristics

Those studies considering these factors are reported in Table 3.

3.1.2.1. Ethnic or Cultural Origin

France and Blampied (1999) suggest that the interaction of associated factors may be accompanied by differential cultural expectations. For example, parental handling of infant sleep is often culturally determined, e.g., co-sleeping is not a common practice in Western culture, and is shown there to be associated with ISD, yet it is a culturally accepted child-rearing practice and norm in non-western cultures, such as Korea (Lee, 1992), Japan (Kawasaki et al., 1994), Kenya (Super & Harkness, 1982), and in the Mayan peninsula in Mexico (Morelli, Rogoff, Oppenheim & Goldsmith, 1992). In 218 Korean families studied by Lee, 98% of the infants slept with a family member, and 16% of the mothers considered the infant's night-time crying to be a problem. Lee claimed that because Korean mothers see crying as part of normal development, they therefore tend to be more tolerant of this night-time crying, although this figure of 16% approaches the lower end of the range noted in western studies. Investigating ethnic differences in ISD between "black" American and "white" American parents, Lozoff, Askeff and Wolf (1996) found that co-sleeping was likely to more problematic for white parents than for black parents supporting earlier findings (Lozoff & Brittenham, 1979; Lozoff, Wolf & Davis, 1985). "Black American parents were found to begin co-sleeping regularly in early infancy, which Lozoff et al. described as a pattern typically found in cultures where co-sleeping is the norm. In contrast, white parents who co-slept, did so when their infants were older, and when parents found night awakenings to be problematic, conflictual and stressful.

Parents who culturally accept sleep disturbance are unlikely to present to a clinic for help. France and Blampied (1999) note that a clinician should not impose cultural values upon a family that the parents do not share. I am in agreement with the views expressed by the CSP (Blampied & France, 1993; France & Blampied, 1999) that cultural practices should not be considered a factor associated with ISD.

France (1989) noted one study that reported an incidence of ISD between West Indian and African mothers, but concluded from three other studies that there was no association between parents' ethnicity and ISD. Scher et al. (1995) conducted their descriptive study with 738 Israeli mothers from two different racial origins and

observed no racial differences within their sample. They reported the rates of ISD from other countries such as Britain, United States and New Zealand were substantially similar.

3.1.2.2. Environmental Factors

France (1989) reported that studies found no association between housing, family support, and sleeping arrangements, family composition (family size), life events and ISD. No contemporary studies could be located that considered associations between these factors and ISD.

3.1.2.3. Maternal Age

France (1989) found no studies reporting an association between maternal age and ISD. Of the studies since then, Scott and Richards (1990) found an association between older mothers and ISD, while other studies did not (Adair et al., 1991; Armstrong & O'Donnell et al., 1998; Benoit, Zeanah, Boucher & Minde, 1992; Jimmerson, 1991; Minde et al., 1993; Scher et al., 1995).

3.1.2.4. Maternal Employment

Studies investigating this have presented contradictory findings (France, 1989). Van Tassel (1985) speculated that their positive association was explained by maternal absence during the day, therefore making bed-time separations more difficult for the mothers. One recent study (Scher, 1991) did report an association, while three other recent studies failed to find this association (Adair et al., 1991; Jimmerson, 1991; Scott & Richards, 1990).

3.1.2.5. Socio-Economic Status and Parental Education

Neither France (1989), nor Messer and Richards (1993) identified any studies that reported an association between social class or economic level, and ISD. Studies since this time (see Table 3) have also failed to find an association (Armstrong, et al., 1998a; Benoit et al., 1992; Jimmerson, 1991; Minde et al., 1993; Scher et al., 1995; Scott & Richards, 1990).

3.1.2.6. Feeding

The findings of studies that have investigated the relationship between ISD and modes of feeding vary (see Table 3). Two studies found a positive association between breast feeding and ISD (Elias, Nicolson, Bora & Johnson, 1986; Wolke et al., 1994), while three studies did not (Johnson, 1991; Macknin, VanderBrug Medendorp & Maier, 1989; Scher et al., 1995). Studies have also failed to find an association between ISD and different methods of feeding (Beal, 1969), changing feeding times

(Johnson, 1991), or between demand or scheduled feeding (Wright, MacLeod & Cooper, 1983) and ISD. Wright et al. did find an association between inconsistent and unsatisfying feedings and frequent night awakenings. No association has been reported between the introduction of solids and ISD (Osterholm et al., 1983), age of sleeping through the night (Grunwaldt, Bates & Guthrie, 1960; Macknin, et al., 1989), or the duration of uninterrupted sleep (Beal, 1969; Parmelee et al., 1964). Elias et al. (1986) found that infants who were weaned earlier slept significantly longer than infants who were not weaned as early.

It has been suggested that studies attempting to associate feeding methods with ISD should be treated with caution (Messer & Richards, 1993). These authors suggested that social and psychological factors may determine the feeding method and changes in these practices may have occurred over the years.

3.2. FACTORS WITH A STRONG ASSOCIATION

3.2.1. Individual Characteristics of the Infant

The results of studies which have considered these factors are also summarised in Table 2.

3.2.1.1. Illness

France (1989) noted in her review that the relationship between illness and ISD was inconclusive. Later studies have also failed to find an association between a history of ill health generally and ISD (Tirosh, Scher, Sadeh, Jaffe, Rubin & Lavie, 1993), or asthma and ISD (Tirosh, Scher, Sadeh, Jaffe & Lavie, 1993).

Other studies with more methodological rigour, have reported an association between some specific illnesses and ISD. Ghaem, Armstrong, Trocki, Cleghorn, Patrick, and Shepherd (1998) found a positive relationship between gastro-oesophageal reflux and ISD, while Kahn, Mozin, Rebuffat, Scottiaux, and Muller (1989) clearly demonstrated an association between milk intolerance and ISD.

Wolfson (1996) suggested that medical problems such as colds, discomfort from teething and ear infections may on occasion disturb an infant's sleep. If an infant with a previous settled pattern of sleep is disrupted by one of the above medical problems, and the disrupted pattern of sleep persists, this will result in secondary sleep disturbance (France & Blampied, 1999).

3.2.1.2. Colic/Persistent Crying

Colic and persistent crying are considered together in this section because they have over-lapping behavioural features, and the terms have been used interchangeably in the literature (Keefe et al., 1996; Papousek & Von Hofacker, 1995). The definition

of colic as: unexplained fussiness, irritability or crying for more than 3 hours a day, on more than 3 days of the week, lasting for more than 3 weeks (Wessel, Cobb, Jackson, Harris & Detwiler, 1954), is now used in recent literature to define infants as "irritable" (Keefe et al., 1996), or as "persistent criers" (St James-Roberts & Plewis, 1996; St James-Roberts, Conroy & Hurry, 1997; St James-Roberts et al., 1998; Papousek & Von Hofacker, 1995). Keefe et al. described persistent crying as a developmental sleep disorder and stated it should more appropriately be termed "irritable infant syndrome".

France (1989) cited one study reporting an association between ISD and colic. Recent studies further support the association with colic/persistent crying with ISD (Keefe et al., 1996; Lehtonen et al., 1994; Minde et al., 1993; Papousek & Von Hofacker, 1995; St James-Roberts & Plewis, 1996; St James-Roberts et al., 1997) and one omitted by France (Weissbluth, Davis & Poncher, 1984). Only Wolke et al. (1995b) failed to find a significant relationship between problematic crying and sleep disturbance in infants who were 5- months-old.

Studies have demonstrated colic/persistent crying to more normally be concurrent with a disturbed pattern of sleep, rather than preceding it. This may be explained by the lack of measures being collected prior to the onset of colic/persistent crying. Further, colic/persistent crying has not been shown to predict sleep problems in later infancy (Lehtonen et al., 1994; St James-Roberts & Plewis, 1996; St James-Roberts et al., 1998; Wolke et al., 1995b). The observation that colic/persistent crying is not predictive of ISD in later infancy may be accounted for by the findings of Keefe et al.'s (1996) study. They reported concurrent, positive correlations between colic and disturbed sleep patterns in early infancy, but noted that improvements in sleep coincided with resolution of persistent crying at 13 weeks. If the improvements in the infant's sleep patterns were maintained through infancy this would explain the lack of predictive validity of colic/persistent crying and ISD.

Researchers suggest it is the day-time sleep patterns of colic/persistent criers that is disrupted, rather than their night-time sleep. St James-Roberts et al. (1997) reported that nearly all of the differences in sleep patterns of persistent criers aged 6 weeks were accounted for during the day. These infants were also evidencing a diurnal cycle, that is they were experiencing more continuous sleep and less feeding during the night, and more wakefulness and feeding during the day. The diurnal regulation of sleeping and waking is one of the main tasks an infant must achieve in the first year (Halpern et al., 1994).

3.2.1.3. Difficult Temperament

In their 1999 review, France and Blampied identified a number of studies (Atkinson, Vetere & Grayson, 1995; Jimmerson, 1991; Sadeh et al., 1994) that

reported sleep-disturbed infants as having certain "behavioural and temperamental features usually associated with a difficult temperament" (p. 4).

France and Blampied also identified studies, reported below, that specified features as difficult temperament to be associated with ISD. (not all of these studies are included in Table 2, as they are already reviewed in France, 1989). The features described are: high activity scores (Blurton-Jones, Rossetti-Ferreira, Farquar-Brown MacDonald, 1978; Carey, 1974; 1975); increased levels of crying (Baildam, Hillier, Ward, Bannister, Bamford & Moore, 1995; Bernal, 1973; Ragins & Schachter, 1971); low malleability and rhythmicity (Keener et al., 1988; Richman, 1981), high irritability (Halpern et al., 1994; Richman; 1981); and less adaptability and mood (Jimmerson, 1991; Scher, Epstein, Sadeh, Tirosh & Lavie, 1992; Van Tassel, 1985). Messer and Richards (1993) concluded from their review that there was an association between sleep disturbance and temperament, specifically, those temperamental features of sensory threshold, adaptability, rhythmicity and approach/withdrawal.

There appears to be sufficient evidence to support the concurrent association of ISD with features of a difficult temperament. It is difficult, however, to determine if features of a difficult temperament influence ISD, or whether the disturbed sleep patterns influence difficult or negative infant features (Jimmerson, 1991; Sadeh, Lavie & Scher, 1994), or if the relationships are reciprocal. This is because behavioural effects of insufficient sleep such as chronic irritability are also used to describe features of a difficult temperament.

Measures of infant sleep have also been shown to predict features of temperament in later infancy. In a recent study, Novosad, Freudigman, and Thoman (1999) found that sleep measures in the first 2 days of life were predictive of classifying infants as "most difficult" on temperament ratings at 8 months. However, that status of temperament in infancy as a predictor of ISD is yet to be clearly established. Studies have mainly reported this association with older infants, and when ISD is already established. Sanson and Rothbart (1995) raise cautions when using temperament as a predictor in infancy. From their literature survey, they concluded that temperament in infancy is a weak predictor for later behaviour problems.

Problems with the measurement of temperament may contribute to difficulties in establishing its causal status with regard to ISD. Scher et al. (1992) claimed that the majority of information regarding the association between temperament and infant sleep "was derived from potentially biased parental reports" (p. 1250). Studies have typically used measures requiring maternal perception of the infants' behaviour. This may have resulted in bias determined by the mothers' perception of whether the infant is a difficult baby or not. Maternal bias can be influenced by stress caused through fatigue and sleep loss resulting from attendance to night awakenings (Halpern et al.,

1994), and/or an irritable, demanding, or withdrawn child (Sanson & Rothbart, 1995). Under both of these conditions, the mother's perception of her infant's behaviour will be negatively affected, and may result in bias when rating the infant's behaviour. Lehtonen et al. (1994) suggested that these negative maternal perceptions may well continue after problems with colic have subsided, as the early parenting practices may continue and the mother-infant relationship remains unsatisfying. Maternal perception of infant behaviour, and the infant's actual behaviour, therefore, are not necessarily correlated with each other. Measuring temperament before the onset of ISD, and using more objective measures, such as independently rating the infants' behaviours from direct recording, may counter the problem of maternal bias (Scher et al., 1992).

3.2.1.4. Self-Soothing Behaviours

France found one study that reported sleep-disturbed infants as less able to self-soothe using an attachment object. Two other studies have also reported this association (Anders et al., 1992; Wolfe & Lozoff, 1989).

3.2.2. Parental Handling Practices

The results of studies which have considered these factors are summarised in Table 4.

3.2.2.1. Parent Management and Night Awakenings

The majority of studies reviewed by France (1989) clearly demonstrated an association between ISD and parental handling following a night awakening. She noted one consistent finding was that parents of sleep-disturbed infants employed a variety of different approaches to management of waking compared with parents of non-sleep-disturbed infants, who were more consistent. A number of other studies have provided support for, and expanded on France's findings. France concluded from her review that sleep-disturbed infants are more likely to be brought into the parental bed (co-sleeping) following an awakening (France, 1989). This finding has been supported by other studies (Crowell et al., 1987; Johnson, 1991; Scott & Richards, 1990; Wolke et al., 1995a, 1995b). Elias et al. (1986) found that infants who co-slept had significantly shorter sleep periods than infants who did not co-sleep. France also concluded that sleep-disturbed infants are more likely to be fed during the night (France, 1989). Two studies not reviewed by France also reported this association (Crowell et al., 1987; Keener et al., 1988).

Recent studies (together with Keener et al., 1988, omitted by France, 1989) show parents of sleep-disturbed infants are more likely to employ a number of other approaches than parents of non-sleep-disturbed infants. These included: parents

being more likely to attend wakings for longer durations (Keener et al., 1988); engaging in a greater number of interventions (Anders, Halpern & Hua, 1992); providing a pacifier, bottle or change feeding times (Johnson, 1991); carrying the infant until he/she falls asleep (Minde et al., 1993); being less likely to leave the infant to cry, and having less consistent schedules for sleeping routines (St James-Roberts et al., 1998). Johnson (1991) reported that while parents were more likely to try a number of methods to manage sleep disturbance, they seldom had success with any of these approaches.

3.2.2.2. Parental Management at Initial Sleep-Onset

Parents of infants with sleep disturbance employ a greater number of different approaches to the management of initial sleep-onset compared with parents of non-sleep-disturbed infants. Parents were more likely to be present at sleep-onset (Adair et al., 1991; Adair, Zuckerman, Bauchner, Philipp & Levenson, 1992; Crowell et al., 1987; Johnson, 1991; Scher et al., 1995; Wolke et al., 1995a, 1995b); to place their infant into the cot asleep (Anders et al., 1992; Keener et al., 1988; Scher et al., 1995); and, to hold the infant during sleep-onset (Crowell et al., 1987). Adair et al. (1991) suggested that parents are more likely to be present at bedtime because they have difficulty separating from their infants. Several authors have suggested that infants who have features of a difficult temperament such as persistent crying, elicit greater parental presence at sleep-onset (Adair et al., 1991), and are both more difficult to put down to sleep and more difficult to console (Keefe et al., 1996; Weissbluth & Liu, 1983).

There is substantial empirical evidence for the concurrent association of ISD and specific parental management techniques for sleep-onset and night awakenings. Except for the findings of Anders et al. (1992) regarding placing the infant down asleep, studies have failed to demonstrate that these parent management approaches precede the onset of ISD. Until specific parent behaviours have been established as preceding the onset of ISD, it can not be known which of these factors predict later sleep problems and therefore have a possible role in causation.

Table 4.
The relationship between parental practices and infant sleep disturbance.

AUTHORS	PARENTAL PRESENCE AT SLEEP ONSET	PLACED DOWN ASLEEP	CO-SLEEPING	PARENT HANDLING AT NIGHT	FEEDING 1. METHOD 2. ROUTINE	PARENT HANDLING DAYTIME
Adair, Bauchner, Philipp, Levenson & Zuckerman (1991)	Positive association					
Adair, Zuckerman & Bauchner (1992)	Positive association					
Anders, Halpern & Hua (1992)		Positive association		Positive association		
Beal (1969)					No association	
Crowell, Keener, Ginsburg & Anders (1987)	Positive association		Positive association			
Elias, Nicolson, Bora & Johnston (1986)			Positive association		1. Positive association 2. Positive association	
Johnson (1991)	Positive association		Positive association	Positive association	1. No association 2. Positive association	
Keener, Zeanah & Anders (1988)		Positive association			Positive association	
Macknin, VanderBrug Medendorp & Maier (1989)					No association	
Minde, Popiel, Leos, Falkner, Parker & Handley-Derry (1993)						Positive association
Scher et al. (1995)	Positive association	Positive association				

Table 4. continued

AUTHORS	PARENTAL PRESENCE AT SLEEP ONSET	PLACED DOWN ASLEEP	CO-SLEEPING AT NIGHT	PARENT HANDLING 1. METHOD 2. ROUTINE	PARENT HANDLING DAYTIME
Scott & Richards (1990)			Positive association	No association	
St James-Roberts, Conroy & Wilsher (1998)				Positive association	
Wailoo, Peterson & Whitaker (1990)				Positive association	
Wolke, Meyer, Ohrt & Riegel (1994)			Positive association		
Wolke Meyer, Ohrt & Riegel (1995a)			Positive association		
Wolke, Meyer, Ohrt & Riegel (1995b)				Positive association	
Wright (1983)				No association	

3.2.3. Parental Factors

The results of studies which have considered these factors are also summarised in Table 3 .

3.2.3.1. Maternal Depression or Malaise

France (1989) noted three studies that reported a positive association between maternal depression, or malaise, and ISD. Three more recent studies support this association (Armstrong & O'Donnell et al., 1998; Armstrong, Van Haeringen, Dadds & Cash, 1998; Scott & Richards, 1990). Minde et al. (1993) did not report a positive association, but found that 50% of the mothers of poor sleepers were anxious and/or depressed. While Goodlin-Jones, Eiben and Anders (1997) did not report on the association between maternal depression and ISD, and are omitted from Table 4, they did present findings pertaining to maternal psychological well-being, maternal interactions and infant sleep. When infants were 6-months-old, Goodlin-Jones et al. found that mothers with lower scores on measures of psychological well-being intervened more with their with infants at night, and had infants who were less likely to self-soothe during the night and who signalled frequently, compared to mothers with high scores. Similar findings were also reported at 12 months of age. The authors claimed that, in the first eleven months, the mothers' sense of well-being is a more important mediating variable for signalling during the night than is the factor of mother-infant interaction. Messer and Richards (1993) concluded that maternal depression was associated with ISD, however, it was unclear if depression was a cause of ISD or a consequence.

In support of this hypothesised relationship, successful treatment of ISD has been shown to improve maternal psychological well-being. Armstrong and O'Donnell et al. (1998) reported a significant decrease in the percentage of mothers who were diagnosed as clinically depressed following management intervention for ISD. Other studies have reported similar findings (Durand & Mindell, 1990; Minde et al., 1993; Mindell & Durand, 1993).

Based on the above findings, Armstrong and O'Donnell et al. (1998) questioned whether some mothers who are diagnosed as experiencing post-natal depression might, in fact, be experiencing sleep deprivation. Van Tassel (1985) found that maternal sleep problems were positively associated with ISD, while Scott and Richards (1990) found that maternal distress increased with the severity and frequency of the child's sleeping difficulty. Scott and Richards concluded that the mothers' lack of well being was a direct result of attending to the infants' night awakenings. Maternal attendance to frequent and/or prolonged night awakenings may inevitably result in disrupted sleep and a reduced amount of total sleep. Chronic sleep deprivation "...may produce symptomology easily confused with that described as post-natal depression"

(Armstrong & O'Donnell et al., 1998, p. 262). In contrast, Zuckerman et al. (1987) suggested that a lack of maternal sleep did not lead to depression, rather that maternal depression influenced the infants' sleep patterns. Armstrong and Van Haeringen et al. (1998) suggested that further research is necessary to establish if maternal mood is induced by the infant sleep pattern or, the sleep pattern is induced by maternal mood.

3.2.3.2. Adult Attachment and ISD

One recent study reported an association between ISD and insecure adult attachment (Benoit et al., 1992). That is, the early childhood relationships and experiences as recalled by the mothers of infants with ISD, were rated as insecure (France & Blampied, 1999).

3.2.3.3. Pre-Natal Parental Sleep Disturbance

From maternal retrospective self report, Armstrong and Van Haeringen et al. (1998) found an association between mothers experiencing sleeping difficulties during all stages of pregnancy, and ISD. These authors concluded that the source of problematic childhood sleep behaviour may lie in the pre-natal period. This finding has not been replicated or addressed elsewhere.

3.3. EFFECTS OF ISD

At this point in the review, comparing and updating France's (1989) review essentially stops. Mainly, because in the last decade studies started to establish empirically, albeit tentatively, the effects of ISD on parents, family functioning, and the infants. A more recent review of this literature has been presented by France and Blampied (1999), and their conclusions will be considered where possible. Studies considering the effect of ISD on family/marital stress are described in Table 3. Those studies considering the effects of ISD on infants are described in Table 2.

3.3.1. Family/Marital Stress

Two studies (Jimmerson, 1991; Scott & Richards, 1990) reported an association between disruption to family life and ISD. Scott and Richards (1990) reported that mothers felt their infants dominated their life, while Jimmerson (1991) reported that mothers of infants with sleep problems reported disruption in family functioning. Benoit et al. (1992) found no such association. Following successful management interventions, parents of sleep-disturbed infants reported improvements in marital satisfaction (Adams & Rickert, 1989; Durand & Mindell, 1990).

Case studies provide further support for this association. Roberts (1993) reported that parents who attended their sleep clinic were "at their wits end", family

life was disintegrating, and marriages were strained to the limit. Some of the parents were beginning to question their affection for their child. Similarly, Szyndler and Bell (1992) found that parents reported that the child's sleep problem was a major issue in their lives. It was the cause of considerable stress, and was causing tension with their partner.

3.3.2. Effects of ISD on the Infant

There is little empirical evidence of the effects of ISD on infants. This may be explicable in that none of the factors described in this section have been clearly demonstrated to precede ISD. In order to establish the effect of ISD on the infant measures prior to the onset of ISD must be collected in order to state the nature and direction of any changes.

Studies have, however, shown that infants with ISD have shorter durations of uninterrupted sleep periods (Anders et al., 1992, Keefe et al., 1996; Keener et al., 1988; Scher et al., 1995), and as France (1989) concluded, experience less sleep overall (Kahn et al., 1989; St James-Roberts & Plewis, 1996; Weissbluth et al., 1984; Wolke et al., 1994).

Comments made by researchers in the field regarding the effects of insufficient sleep on infants must be noted. Infants who do not experience sufficient sleep have been described as experiencing tiredness, chronic irritability, heightened emotionality, diminished attention span and lack of behavioural control (Blum & Carey, 1996; Dahl, 1998; Symon, 1998). Whether in fact these problems precede ISD, or are a consequence needs to be addressed.

3.4. FACTORS ASSISTING ORGANISED SLEEP DEVELOPMENT

In their recent review France and Blampied (1999) examined the literature in order to describe the conditions under which sleep-wake organisation proceeds most rapidly. They concluded that the optimal conditions for the development of organised infant sleep involve low and co-ordinated stimulation. For example, they cited studies that employed different care regimes under which the infants' sleep-states matured faster. These included less disturbing care regimes (Gabriel, Grote & Jonas, 1981), continuous feeding (Salzarulo & Fagioli et al., 1980) or rhythmic care (Gatts, Fernbach, Wallace & Singra, 1995). While these studies investigated the development of sleep with predominantly pre-term infants, these results still have implications for full term infants given that prematurity is not in itself associated with ISD.

3.4.1. Self-Soothing Behaviours

In a short-term longitudinal study with 21 infants, Anders et al. (1992) employed TLVR to determine if an infant was a "self-soother" or not. A self-soother was defined as an infant who resumed sleep unassisted following an arousal. By 3 months, self-soothers were more likely to be put into the cot awake, and not cry upon awakening compared with problem sleepers. In addition, infants who used a sleep-aid slept for significantly longer periods. At 8 months, the self-soothers were still more likely to be put into the cot awake and to use a sleep aid compared with the problem sleepers. Data was not collected during the intervening months, so it is not possible to establish when infants first learn to engage in the self-soothing behaviours, and under what conditions. Goodlin-Jones et al. (1997) also reported that the more often the infants were put into the cot awake, the more often they exhibited self soothing behaviours following an awakening, and the fewer times they signalled on awakening during the night.

3.4.2. Leaving Infants to Settle Alone with Scheduled Feeding and Sleeping Routines

In a longitudinal study St James-Roberts et al. (1998) found that 5-month-old infants slept through the night earlier when their mothers were more scheduled in their approach to their infants' sleeping and feeding. This was in comparison with infants whose mothers employed a less consistent approach, and who were also reluctant to leave the baby alone when he/she cried. The former group of infants also had lower behaviour problem scores. On the basis of these findings St James-Roberts et al. concluded, in agreement with Patterson (1982, in St James-Roberts et al., 1998), that clear boundaries and scaffolds for learning are associated with lower rates of behaviour problems.

3.5. METHODOLOGICAL CONSIDERATIONS

France (1989) noted from her review of the studies investigating factors associated with ISD, that:

Clear relationships have been established between ISD and some variables such as infant temperament, some measures of parental handling and maternal depression but these associations have not been coherently explained in a manner which increases understanding of ISD or leads to further research. (p. 70)

Generally speaking, there has been a paucity of attempts to investigate the causal mechanisms of ISD. There has, however, been an increase in the number of studies that have employed more rigorous and sophisticated methodology. This has

resulted in the refining of our understanding of certain risk factors, allowing for progress in the investigative areas of infant regulatory disturbances and parental handling practices. The lack of theoretical explanations, however, still limits the value of these findings to our understanding of infant sleep development and their usefulness, therefore, for guiding prevention.

A number of the methodological considerations France (1989) addressed over a decade ago are considered and discussed below. The problems within this area of the literature can be divided into those of interpretation, and those of execution.

3.5.1. Problems of Interpretation

France (1989) noted that a lack of conceptual sophistication resulted in studies describing the presence or absence of correlations, but making little or no advance in theoretical understanding of the processes involved. This criticism applies to many of the studies reviewed in this chapter. Three studies, however, are an exception to this (Adair et al., 1991; Anders et al., 1992; Lozoff et al. 1996). Adair et al. (1991) tested Ferber's (1985) theoretical model of sleep-onset association and parental handling, while Anders and colleagues have presented an explanatory model of ISD (described in Chapter Seven) and represents an advance in theoretical and conceptual sophistication. In families where co-sleeping is not a cultural practice, Lozoff et al. suggested that co-sleeping occurs in response to an infant whose sleep is problematic at initial sleep-onset and night awakening. These authors proposed that infants who become accustomed to co-sleeping have difficulty resuming sleep following a night awakening, and will protest when left to fall asleep on their own. Co-sleeping is suggested to be a better alternative to dealing with night awakenings as it involves less conflict, and less stress than when attempting to leave the infant in his or her own bed to resume sleep.

3.5.1.2. Lack of Explanations

France (1989) noted there are too few attempts by studies to propose explanations based on established theoretical perspectives and what is already known about factors underlying ISD. Several studies (e.g., Beal, 1969; Crowell et al., 1987; Johnson, 1991; Scott & Richards, 1990; Scher, 1991; Scher et al., 1995; Wooding, Boyd & Geddis, 1990) present a number of observed associations, but it is difficult to interpret these associations without a theoretical perspective which allows for clear predictions regarding the expected effects. For example, the association between the parental management strategy of co-sleeping and ISD has been well reported, and except for Lozoff et al. (1996), the relative causal significance of the respective mediating factors is rarely considered. When they are considered, the explanations are

not sufficient to test causal mechanisms. Wolke et al. (1994, 1995a, 1995b) for example presented substantial findings on ISD and co-sleeping, and concluded it was an acquired strategy to deal with sleep problems, but they made no attempt to explain how this conclusion was reached.

3.5.1.3. Lack of Cause and Effect Relationships

The majority of the research is either correlational (Adair et al., 1991; Crowell et al., 1987; Johnson, 1991; Scott & Richards, 1990), or cross-sectional in design (Armstrong et al., 1994; Ghaem et al., 1998; Scher et al., 1995; Tirosh et al., 1993; Wooding et al., 1990). Hence, it is unidirectional, making it difficult to establish a cause/effect relationship with ISD, or to provide an understanding of the causal mechanisms through which any associated factors might act. Despite their number, their correlations have not established the different pathways channelling the development of different sleep patterns. Unless measures are collected prior to the onset of ISD then it is unclear whether an associated factor is caused by the sleep disturbance or the other way around (France, 1989).

There is a lack of longitudinal research into the factors associated with ISD (Pollock, 1992). Of the few studies that report short-term longitudinal measures, the main emphasis has been investigation of colic/persistent crying (Keefe et al., 1996; St James-Roberts et al., 1998), or studies have reported data at only three ages across 15 months of the study (St James-Roberts et al., 1998; Wolke et al., 1995a). More developmental data and a finer grain of analysis would assist in identifying the direction of relationships between risk factors and ISD.

3.5.1.4. Conceptual Errors in Research

An absence of conceptual clarity has meant the effort and time expended by investigative studies in answering important questions has been wasted, and many of these studies also failed to consider behavioural principles in their explanations (France, 1989). For example:

1. Authors assume more continuity than is actually the case in child-rearing practices across different ages. Methods used in early infancy may not be employed with older infants, or in middle childhood. The aggregation of data from early infancy across the first 4 years provides little developmental information. For example, Scher et al. (1995) aggregated data, to include the data, of infants 4 months to 4 years of age, to describe parents' settling techniques and comforting strategies. Similarly, Michelsson et al. (1990) treated the data in the same manner as Scher by including infants from 3 to 8 months, as did Osterholm et al. (1983), with infants 6 to 12 months of age.

2. Authors assume more homogeneity than is actually the case in the sleep patterns of infants of different ages. Figures for infants who were younger than the defining age for ISD have been included with that of much older infants (e.g., Michelsson et al., 1990; Scher et al., 1995). There are a number of developmental differences between the sleep-wake organisation of young infants and older infants (Anders & Keener, 1985; Anders et al., 1985). For example, infants younger than 6 months typically require feeding at night for strictly physiological reasons. Aggregating their data with older infants who no longer require night feedings is inappropriate, and it provides little relevant information.

3. The fact that parents of sleep-disturbed infants use a variety of techniques to manage this problem is rarely explained in the literature. This is unfortunate, as it is conceptually important and very likely has the effect of increasing and maintaining sleep disruptions. This may be because of the effect of intermittent reinforcement schedules on the child, or may be the effect of ratio strain on the parents. Recent studies asked whether the infant had been left to cry, but failed to investigate the conditions under which that occurred (e.g., Johnson, 1991; Scott & Richards, 1990). Similarly, not one of the studies reporting parents placing an already asleep infant into the cot investigated conditions under which this occurred. For example, did parents place the infant down asleep in order to avoid the infant's crying when left alone? Was there a history of failed attempts by the parents to leave the infant to settle alone. Did parents leave the infant to cry, and were then negatively reinforced for attending? Had the infant been positively reinforced for crying, when left to fall asleep alone in the unfamiliar environment of the cot, by having the parent present until falling asleep in the future?

3.5.1.5. Lack of Attempts to Clarify These Questions

In her review, France (1989) raised the point that simple steps could have been taken to clarify some of the questions regarding the parent management of infant sleep disturbance. For example, it would not be difficult to ask parents of infants without sleep disturbance if they had initiated any attempts to prevent it, or to ask whether parents of sleep-disturbed infants have different beliefs about parenting, and if these changed over time because of their experiences in parenting. Unfortunately, the recent research has yet to do this.

3.5.2. Problems in Execution

As France (1989) concluded from her review, that studies reporting associations with ISD demonstrate serious problems in their execution. This more recent review has also found that studies are still demonstrating problems in their execution.

3.5.2.1. Reliance on Self-Report Measures

Most studies employed retrospective parental report (Adair et al. 1991; Armstrong et al., 1994; Johnson, 1991; Michelsson et al., 1990; Scher et al., 1995; Scott & Richards, 1990; Weissbluth et al., 1984). Studies investigating the accuracy of retrospective parental recall and child behaviours have highlighted limitations of such measures (Chess, Thomas & Birch, 1966; Robbins, 1963). Parents are generally inaccurate when recalling specific information about child-rearing practices and their child's early developmental progress. Parent's recall was affected by the social desirability of their response, and their inaccuracies tended toward the direction of matching experts' expectations (Robbins, 1963). Findings based on parent report for night awakenings, are likely to be influenced by care-giving practices and attitudes (Messer & Richards, 1993).

3.5.2.2. Lack of Standardised Measures

It is difficult to directly compare the findings of the studies in the area of ISD. As France (1989) found, there has been little attempt to employ standard measures of infant sleep problems, parental behaviour or temperament. Halpern et al. (1994) was the only study to employ a standard measure of infant temperament by using the Infant Characteristics Questionnaire (ICQ, Bates, Freeland & Lounsbury, 1979). Other studies have measured infant temperament, but have used the Toddler Temperament Questionnaire (TTQ, Carey & McDevitt, 1978, e.g., Atkinson et al., 1995; Keener et al., 1988; Sadeh, et al., 1994; Scher et al., 1992) designed for children of varying ages.

A further difficulty in the comparison of studies is inconsistency in the measurement of infant sleep. Some studies have grouped children on the basis of their sleep behaviour, such as the frequency of night waking (Minde et al., 1993; Osterholm et al., 1983; Scott & Richards, 1990; Wolke et al., 1994), while others grouped the children based on parent ratings (Johnson, 1991; Scher et al., 1995; Scher, 1991).

3.5.2.3. Lack of Developmental Data

Lack of developmental data in studies considering infant and parent factors associated with ISD makes it difficult to establish whether they precede ISD. This is because studies have tended to collect concurrent measures, or have utilised parents retrospective recall of events preceding ISD, which is not sufficient for establishing the prodromal status of a factor which might be targeted for prevention. Clearly a longitudinal design, ideally with repeated measures over successive ages for the first 12 months, is required so that changes can be seen to at least antedate the onset of ISD. Questions critical to planning for prevention can then be addressed. These include: which parental behaviours precede the onset of ISD (and when do these first

occur)? and what parent behaviours are predictive of primary ISD (and at what age are they first predictive)? Until these questions can be addressed, the description of the associated factors are of little value to understanding the pathways to ISD.

3.5. SUMMARY

1. The identification of modifiable risk and protective factors is essential to the design of preventive interventions.
2. Factors with a weak association with ISD include: Birth order, gender, heritability, perinatal events, prematurity, family composition, maternal age, maternal employment, socio-economic status, parental education, and feeding methods.
3. Infant factors with a strong association include: Illness, colic/persistent crying, and temperament. It has yet to be established whether they precede or are a consequence of ISD.
4. Parents of sleep-disturbed infants are more likely to be: present at sleep-onset; to place an already asleep infant into the cot; hold the infant until he/she falls asleep; to co-sleep following an awakening; to feed the infant; to engage in more interventions at sleep-onset and night awakenings; and, not to leave the infant to cry (when compared to parents of non-sleep-disturbed infants).
5. Placing an infant down asleep has been shown to precede and predict later ISD. While the other parent factors are concurrent with ISD, it is yet to be shown whether they precede or occur as a consequence of ISD.
6. Maternal depression or malaise, and an insecure adult attachment style, are associated with ISD. The direction of the causal role is unclear.
7. Infant sleep disturbance is a major disruption to family life.
8. Infants are negatively affected by sleep disturbance.
9. Optimal conditions of low and co-ordinated stimulation, self-soothing, and consistent routines are associated with the development of organised infant sleep.
10. Problems in execution of studies include reliance on self report, the use of retrospective measures, and a lack of standardisation of measures and definitions of variables.
11. Prospective, longitudinal repeated measures are necessary to establish factors that precede, and also demonstrate predictive validity of ISD. This would inform the causal status of factors, and which are amenable to prevention.

3.6. CONCLUSION

The aim of this chapter was to identify and describe those risk and protective infant and parental factors found to be associated with ISD. The causal role of factors was also examined by establishing whether they preceded ISD, which has important implications for the planning of preventive intervention. Because a factor is significantly associated with ISD it does not necessarily denote causality.

From the literature a myriad of factors have been identified as associated with ISD. This review has, however been unable to generally establish the causal role or the direction of influence of the associated factors on the development of ISD. It is therefore not possible to establish: (i) which factors affect infants' sleep patterns at different developmental points; and (ii) the consequential pathways to different sleep outcomes. Without this information it is unclear which factors could or should be manipulated at different developmental points in the service of ISD prevention.

Clearly a prospective longitudinal study is needed that begins in very early infancy, prior to the onset of ISD, and which collects successive measures of both parental and infant behaviours. It may then be possible to identify which factors precede ISD, which factors are or are not predictive of ISD, and the factors that mediate its development. Only then can an empirically validated preventive intervention be conducted with confidence.

CHAPTER FOUR

WHAT THE MANAGEMENT LITERATURE CAN TEACH ABOUT PREVENTION

Scientific evidence of the causal role that a risk factor plays in the development of a disorder is seldom available until a preventive intervention is tried (Mzarek & Haggerty, 1994). Despite this, Mzarek and Haggerty state that a number of critical pieces of evidence should be in place when planning preventive intervention. In the case of ISD, critical pieces of evidence regarding the causal role of parent behaviour have been provided by empirical studies that have employed operant principles for its management. While the management literature is not aetiological, the successful implementation of operant principles has demonstrated the role of parent behaviours in the maintenance of ISD (Adams & Rickert, 1989; Durand & Mindell, 1990; France & Hudson, 1993; Lawton et al., 1991; Mindell & Durand, 1993; Piazza & Fisher, 1991; Pritchard & Appleton, 1988; Sanders, Bor & Dadds, 1984; Rickert & Johnson, 1988; Rolider & Van Houten, 1984). The findings of the management literature, therefore provide important contributions to the knowledge base about risk factors that is necessary when planning preventive intervention. It would be expected then, that the prevention literature would consider the contributing factors identified in the management literature.

This chapter examines the management literature in order to clarify these underlying factors. Principles of operant behaviour theory will be employed to clarify the role of contributory parent behaviours. Key operant assumptions from Blampied and France's (1993) behavioural model of ISD will be referred to. These include: stimulus control, reinforcement, extinction, and the Post Extinction Response Burst (PERB). The model provides a clear and empirically-driven conceptual framework within which the roles of operant principles and ISD are explained.

A recent review of behavioural interventions (Owens et al., 1999) has been chosen to provide the overview of different intervention approaches. This review was chosen over other recent reviews (e.g., Mindell, 1999) because it: (i) differentiates the components of some approaches; (ii) differentiates different types of extinction programmes; and, (iii) includes studies of behaviour management in combination with extinction. Given the importance of operant principles in understanding ISD the review which provides the closest analysis is preferable. Owens et al.'s review is summarised according to the operant principles and follows description the operant principles.

4.1. OPERANT PRINCIPLES AND PARENT BEHAVIOUR

4.1.1. The Power of Stimulus Control

One of the best ways to identify stimulus control of operant behaviour is to look for the stimuli that precede and best predict the given behaviour.

(Baldwin & Baldwin, 1981, p. 88)

Clear stimulus control over the elements in the going-to-bed/falling-asleep-behaviour-chain is necessary for the development of appropriate sleep patterns (Blampied & France, 1993; Bootzin, 1977; France & Blampied, 1999; Sanders et al., 1984). In order for reliable and appropriate sleep to occur, preparation for, and falling asleep must be under the control of appropriate discriminative stimuli (S^D s) (Bootzin, 1977). In fact, each component of the behavioural chain may have separate S^D s and both internal and external cues may provide S^D s for the next component in the chain. Without appropriate S^D s for falling asleep it is likely that individuals will have sleep initiation difficulties. Bed refusal and sleep-onset delay occur due to the absence of external cues that set the occasion for the falling asleep behaviour chain (Blampied & France, 1993).

Parents can provide appropriate or inappropriate external S^D s cues for sleep-onset throughout the bedtime behaviour chain. Behavioural quietude is one of the first sequences in the chain that needs to be brought under appropriate discriminative stimulus control (Blampied & France, 1993). When an infant is placed into the cot asleep, inappropriate cues have been provided for sleep-onset. Parents have precluded the infant from experiencing exposure to the immediate bed environment and from developing appropriate stimulus control of sleep-onset from bed-related cues. Appropriate stimulus control develops when infants are placed in the cot awake and left unattended. They may then evidence some distress, and signal. If a parent then attends and remains with the infant until sleep-onset, the parent will provide the infant with S^D s of parent-related cues rather than bed-related cues for sleep-onset. Parent-related cues are inappropriate S^D s for an infant needing to learn sleep self-initiation skills.

Self-produced behaviour cues such as thumb sucking and the use of soft toys or bedding are a further aspect of the discriminative control of sleep initiation (France & Blampied, 1992). These behaviour cues facilitate sleep, and may have a role in sleep-onset by "assisting in the achievement of behavioural quietude" (p. 484). Due to their temporal proximity to sleep-onset, cues that involve the use of a sleep aid are seen as effective S^D s for falling asleep, and may also become powerful conditioned reinforcers. However, if a parent provides inappropriate S^D s such as rocking, cuddling, or carrying

the infant around, the parent has prevented the infant from learning the appropriate SDs of self-produced comfort cues for sleep initiation.

A further element of stimulus control involves having a regular sleep-wake time, where the infant is placed into the cot around the same time each day, and in a fixed sleeping place that is provided consistently in association with bedtime (France & Blampied, 1999; Owens et al., 1999). This may allow the infants' circadian rhythms to become synchronised with the sleep-wake cycle (Piazza & Fisher, 1991).

Following a night awakening, infants' resumption of sleep will occur more or less rapidly and effectively to the degree that setting events for sleep-onset are present (Blampied & France, 1993; Ferber, 1985). In brief, if an infant awakens at night and the appropriate SDs from the sleep-onset environment are present (such as cot and self-produced comfort cues) this will then set the occasion for falling asleep again. If the infant has only been exposed to inappropriate SDs for sleep-onset (such as parental presence, being rocked, cuddled or being placed down asleep) these parent-associated cues will need to be reinstated for resumption of sleep following an awakening.

4.1.2. The Power Of Reinforcement

4.1.2.1. Parent Attention as Reinforcement

Reinforcers that follow an operant increase the likelihood that the operant will occur in the future.

(Baldwin & Baldwin, 1981, p. 9)

There are difficult developmental judgements involved in deciding necessary versus overly-intensive parental attending in response to an infant's night awakening. During the first six months awakenings are universal and the infant's nutritional needs must be met. Across all ages their safety needs must also be met. The findings from the management literature and the role of the type of parental attending that is associated with ISD is described.

Parental attention to an infant's crying or distress during the sleep-onset period and/or following a night awakening has consequences for both the infant and parents if it is sufficiently reinforcing. The infant will be positively reinforced for emitting distress behaviours such as crying by having the parents attend to them, while the parents will be negatively reinforced with the termination of the aversive stimulus of the infant's crying (Blampied & France, 1993). These competing parent and infant behaviours are under powerful double reinforcement contingencies which can create a behaviour trap, referred to as a "coercion trap" (Patterson, 1982, in Blampied &

France, 1993). The sleep disturbance is maintained as parents and child act to avoid aversive circumstances: the parents to avoid the infant's distress behaviours which they experience as aversive, and the infant to avoid being alone in a distress-evoking environment where they must fall asleep alone (Blampied & France, 1993). This double reinforcement contingency will assist the infant and parents to learn to anticipate each other's behaviour. In doing so, the infant's crying will become increasingly intensive, and the parental behaviours will become more immediate, extensive and intensive (France & Blampied, 1999). Consequently, this behaviour trap will continue to shape and maintain the infant's sleep-onset disturbances, night awakenings, and co-sleeping, and the parent's response to these.

4.1.2.2. When Attending Parental Behaviours are Withdrawn

A behaviour maintained by positive reinforcement is placed on extinction when the reinforcing stimulus is no longer forthcoming as a consequence of the behaviour.

(Cooper, Heron & Heward, 1987, p. 379)

In the case of infant sleep, infants sleep-disturbed behaviours are extinguished when the reinforcing stimulus of parental attendance is withdrawn. Extinction is an outcome, not a process, in that it results in the cessation of the target behaviour. In the area of ISD, extinction, systematic ignoring or planned ignoring has been defined as "the removal of positive reinforcement for bedtime resistance, and for signalling during settling and on awakening. That is, the child is not attended to, once put to bed, unless the parents judge it to be absolutely necessary " (Owens et al., 1999, p. 5).

Withdrawing parent attention to treat ISD relies on the assumption that parental attention is a key variable for the initial reinforcement and subsequent maintenance of infants' sleep-disturbed behaviours.

4.1.2.3. Post-Extinction Response Burst (The Unexpected PERB)

Parents need to expect their infant's behaviour to "get worse before it gets better" and to welcome the PERB as a sign that effective contingencies are being changed.

(France et al., 1996, p. 592)

When parents remove the reinforcement that is maintaining the sleep-disturbed behaviours the infant will resist the change in contingencies. The parents will most probably experience an increase in the intensity and variability of infant crying or other behaviours, rather than an immediate decrease in the infant's crying (France & Blampied, 1992). It does however precede a decrease in the sleep-disturbed behaviours (France et al., 1996) but the infant's resistance to extinction results in distress to both the parents and infant (Owens et al., 1999).

4.1.2.4. The Effects of Intermittent and Negative Reinforcement

An intermittent reinforcement schedule produces behaviours that are more resistant to extinction.

(Cooper et al., 1987, p.385)

Parents whose ambivalent and occasional attempts to ignore their infants disturbed sleep-onset and night awakenings will intermittently reinforce these behaviours. Each failed attempt at withdrawing the reinforcing behaviours will serve to strengthen and shape the infant's resistance to any future attempts at extinction (France & Blampied, 1999; France et al., 1996; Messer & Richards, 1993). This will also increase the parents' avoidance and serves to strengthen the coercion trap (France & Blampied, 1999) through negative reinforcement.

While this behavioural principle describes how parents can shape infant's resistance, and strengthen the coercion trap, it also has implications for management studies that employ modifications of systematic ignoring. In these interventions parents have gone from a schedule of continuous reinforcement of the infant's sleep-disturbed behaviour to an extinction procedure that involves a schedule of intermittent reinforcement.

When an infant is placed on an intermittent schedule he or she may have difficulty discriminating that extinction has begun, because the parents are still attending on some sort of schedule. Consequently, the change in the frequency or duration of infant crying declines more slowly (Rolider & Van Houten, 1984).

Further, progressively thinner ratio schedules are effective in maintaining behaviour because they produce persistence or "stick-to-it-iveness" (Baldwin & Baldwin, 1981, p. 227). An infant who continues to persistently cry may eventually be reinforced by parental attendance. The infants have learned to persevere by crying for longer periods of time.

4.2. EFFICACY OF STUDIES EMPLOYING OPERANT PRINCIPLES

4.2.1. Studies Employing Stimulus Control

Owens et al. (1999) located one controlled and three uncontrolled studies that employed some elements of stimulus control as the predominant strategy (Ashbaugh & Peck, 1998; Bidder, Gray, Howells & Eaton, 1986; Galbraith et al., 1993; Weissbluth, 1982). The elements of stimulus control included establishing bedtime routines and appropriate cues for sleep-onset. Owens et al. noted that all of these studies reported improvements in the infants' settling.

Unfortunately, it is difficult to determine the treatment efficacy of stimulus control per se because it is typically employed in conjunction with other behavioural treatment strategies. Owens et al. (1999) noted that the majority of extinction based treatment programmes employed elements of stimulus control which involve establishing regular bed-times.

4.2.2. Studies Employing Extinction

Studies employing extinction (operationalised as systematic ignoring) constitute the largest body of published studies in the area of behavioural interventions of ISD. Extinction is the most rigorous, and effective treatment. There are two major classifications of extinction based programmes: unmodified systematic ignoring and modifications of it.

4.2.2.1. Studies Employing Unmodified Systematic Ignoring

Owens et al. (1999) identified one case study and three experimental studies that employed systematic ignoring of sleep-disturbed behaviours (France & Hudson, 1990; Reid et al., 1999; Rickert & Johnson, 1988; Willams, 1959). Systematic ignoring resulted in reduced settling time and fewer night awakenings in each study. Messer and Richards (1993) concluded from their review that this technique was both effective and fast in ameliorating sleep-disturbed behaviours.

4.2.2.2. Studies Employing Modifications of Extinction

The minimal check programme involves parents checking the infant (in response to signalling) at regular intervals. Owens et al. (1999) described improved sleep patterns in three studies investigating the effects of this intervention (France & Blampied, 2001; Pritchard & Appleton, 1988; Sadeh, 1994). Owens et al. could not establish whether the effects of the minimal check programme were as robust as those of unmodified extinction. The findings of a pilot study indicate that it does not lead to a reduced amount of infant crying compared with parental presence or the unmodified systematic ignoring programmes (France & Blampied, 2001). France and Blampied recommend systematic ignoring in conjunction with parental presence as the programme of choice as it results in rapid resolution of night awakenings and crying.

During a parental presence programme a parent sleeps in a separate bed in the same room as the infant for a period of one week. The parent has no verbal or physical contact with the infant. At the end of the week the parent resumes sleeping in the parent's bed and continues with an unmodified extinction procedure. Owens et al. (1999) concluded studies that employed this procedure were effective in reducing sleep disturbance, and decreasing the PERB (France & Blampied, 2001; Sadeh, 1994). Marked improvements in infant sleep were also noted in studies that employed

incremental extinction where parents delayed their response to crying, and then systematically increased the time delay before responding (Adams & Rickert, 1989; Durand & Mindell, 1990; Reid et al, 1999; Rolider & Van Houten, 1984). Owens et al. described a study where this procedure was implemented at bed-time only (Mindell & Durand, 1993). There was a reduction of night awakenings in all but one child. Owens et al. also described the efficacy of a decremental graduated extinction programme where the parents systematically decrease the time interacting with the infant during settling and night awakening (Lawton et al., 1991). Eight of the 10 subjects showed improvements that were maintained at follow-up, however the PERB did not necessarily decrease.

4.2.3. How the PERB can Thwart Parental Attempts at Intervention

There are two critical phases during the progression of extinction-based programmes when the intensity in the infant's crying may lead parents to believe that the programme is no longer effective. They may therefore discontinue with treatment because they do not have an understanding of the increase in the infant's crying (France et al., 1996). The first phase in the PERB was described earlier. The second phase is a spontaneous recovery period of night crying occurring after the "honeymoon" phase where the infant has initially responded to the programme (France et al., 1996). Spontaneous recovery does not return the behaviour to the pre-extinction level (Baldwin & Baldwin, 1981), nevertheless, at this point the spontaneous bursts of intense infant crying may lead the parents to believe that the programme is not longer effective, and discontinue it.

4.3. IMPLICATIONS FOR PREVENTIVE INTERVENTION

Operant behavioural principles demonstrate parental behaviours as mechanisms maintaining (if not causing) ISD. The management literature has employed these principles to effectively ameliorate ISD. These behavioural concepts may therefore have implications for the planning of preventive intervention. That is, each of the behavioural principles identifies contributing parental behaviours that can be directly manipulated as antecedent (setting) and consequent events controlling sleep related behaviours.

Specifically, in order for the development of appropriate sleep self-initiation at initial sleep-onset there are a number of setting events that must come under appropriate discriminative stimulus control. Parents need to supply the appropriate bed-related cues such as having a regular bedtime, placing the infant into the cot awake, and allowing the infant to fall asleep alone. If an infant is not provided with these events, and evidences distress when left alone at sleep-onset, the immediacy and

intensity of the parents' response will determine future behaviour in these circumstances. By attending to the infant immediately, the parents will deprive the infant of an opportunity to learn to self-soothe, or develop other cues for sleep self-initiation.

Parental responses to the infant's night awakenings can be also be manipulated so they are not sufficiently reinforcing to maintain crying upon awakening. If parental response to an infant's crying is minimally intrusive, and not sufficiently reinforcing, the crying will decrease to a low frequency (France & Blampied, 1992). These parental responses must remain consistent. If not, they will provide intermittent reinforcement for the infant's crying upon awakening. Similarly, if the safety and physiological needs of the infant have been met, and the parents decide to withdraw their attending to night awakening, they must also be consistent. If parents are not consistent, and attend infrequently to the infant the parents will again provide intermittent reinforcement which serves to strengthen the infant's resistance behaviours.

A causal role for these operant mechanisms has yet to be established. It may be that some of the parental behaviours maintaining ISD are causal, and would therefore precede and predict ISD. Studies testing these straight-forward hypothesis have yet to be carried out. A longitudinal normative design should be used to measure the related variables and establish their predictive validity for ISD. This thesis aims to do this.

Findings of the management literature should be extrapolated to preventive intervention in the following ways:

1. During the bedtime behaviour chain parents would provide appropriate discriminative stimulus control by:
 - Having a regular bedtime routine,
 - placing the infant into the cot awake,
 - leaving the infant to fall asleep without parental assistance.
2. Parents do not immediately attend to their crying infant during sleep-onset or following a night awakening. An opportunity is then be provided for the infant to learn self-soothing strategies.
3. Parents response to crying upon awakening would be minimally intrusive, and of low intensity, and they avoid co-sleeping as a management strategy for night awakenings.

4. Parents would be consistent when withdrawing reinforcing behaviours, such as attending during sleep-onset delay; remaining with the infant until sleep initiation; attending following a night awakening to avoid the effects of intermittent reinforcement.
5. That parents would be aware of the PERB, so they would understand the intensity of their infant's response if they attempt to extinguish infant responses.
6. Modifications of extinction could be taught to parents using preventive strategies. For example, minimal check could be used when parents decide to decrease their attendance to night awakenings, or parental presence (following the rules) could be used at sleep-onset if an infant has sleep-onset delay.

These predictions could also serve as a platform for evaluating preventive interventions.

4.4. SUMMARY

1. Management studies employing behavioural interventions have provided critical pieces of evidence regarding the contribution of parental behaviours and their role to the maintenance of ISD.
2. The underlying causal mechanisms may be the operant behavioural principles of stimulus control, reinforcement, extinction, the PERB and the coercion trap.
3. Each of these behavioural principles has implications for preventive intervention. They identify parental risk factors that are malleable or modifiable for preventive intervention.
4. There is a need for a longitudinal normative study to establish the predictive validity of these contributing parent behaviours.
5. It would be expected then that these behavioural principles could be extrapolated to inform the component of prevention.

4.5. CONCLUSION

Findings from the management literature have demonstrated the role of contributory parental behaviours in the maintenance of ISD. These have been explained by basic operant behavioural principles contributing to the research base by informing on the components that can be considered for prevention. Each of the principles should therefore be supported by the prevention literature. Specifically, the use of stimulus control during sleep-onset to assist an infant learn sleep self-

initiation; how parent behaviours can serve to reinforce and maintain any emerging sleep-disturbed behaviours; how extinction can assist in the cessation of emerging sleep disturbance; and an understanding of the PERB and how it can thwart parents attempts to better manage their infants sleep.

CHAPTER FIVE

PREVENTIVE INTERVENTION FOR INFANT SLEEP DISTURBANCE

The next step in the preventive intervention research cycle is the consideration of prior preventive interventions (Mzarek & Haggerty, 1994). As described in Chapter One, three levels of preventive intervention can be provided, primary, secondary, and tertiary. Primary prevention involves the reduction of the incidence of the onset of a disorder (Coie et al., 2000), and this level was provided by previous empirical prevention studies for ISD (Adair et al., 1992; Goodlin-Jones et al., 1997; Kerr et al., 1996; Pinilla & Birch, 1993; Wolfson, Lacks & Futterman, 1992). Primary prevention is also the focus of this thesis.

Empirical research specific to preventive intervention for sleep disturbance in infants is scarce, with all the preventive studies being published within the last decade. (Adair et al., 1992; Goodlin-Jones et al., 1997; Kerr et al., 1996; Pinilla & Birch, 1993; Wolfson et al., 1992). Despite similarities in target behaviours (both infant sleep-wake behaviours, and parent-infant interactions) these studies demonstrate a wide variation in their rationale, the age at which the intervention was implemented, their intervention strategies, and the degree of the infants' exposure to intervention. It is therefore difficult to directly compare the results of these studies, or to establish clear conclusions regarding their efficacy.

Generally, the studies demonstrated positive effects. Very young infants were shown to consolidate their sleep patterns at an early age (Pinilla & Birch, 1993; Wolfson et al., 1992), while intervention with older infants, at 3 months (Kerr et al., 1996) and 4 months (Adair et al., 1992), resulted in fewer night awakenings in treatment group infants compared to control infants at 9 months of age. While Goodlin-Jones et al. (1997) reported no difference in infant sleep architecture, their control mothers reported an improved sense of well-being.

Wolfson et al. (1992) and Adair et al. (1992) were the first studies to empirically investigate preventive intervention for ISD, thereby providing groundbreaking research in the area of infant sleep. Since then Wolfson et al.'s study has been replicated, in part, by Pinilla and Birch (1993), who specifically targeted breast-fed infants. But, as is the case with such early research, methodological and conceptual issues will need to be addressed in order to further the field. For example, although the studies had some follow-up, future studies need to establish whether improvements are maintained in

the long term, specifically to the age when primary ISD is first defined at 6 months. Further examples of these issues are described later in this chapter.

This chapter critically reviews the prevention literature. This involves examining the five published studies that have conducted empirical investigations in the prevention of infant sleep disturbance. The descriptions of the intervention programme, the research methods used, and the evidence presented concerning implementation and outcome are considered. Again, the criteria for examining these factors have been adapted from Mzarek and Haggerty's (1994) framework for evaluation of the methodological rigour of preventive programme. Each study is also examined to establish its conceptual validity, i.e., whether the intervention considered any of the operant behavioural principles described in Chapter Four.

5.1. DESCRIPTION OF THE INTERVENTIONS

The description of each intervention programme is summarised in Table 5.

5.1.1. Goals and Intervention Protocols of the Five Studies

1. Wolfson et al. (1992). In order to establish if infants would demonstrate better sleeping patterns, Wolfson et al. conducted the first and most comprehensive study. This tested the efficacy of recommendations in a self-help book for parents by Cuthbertson and Schevill (1985, in Wolfson et al., 1992). Twenty-nine primiparous couples were randomly assigned to a treatment condition, and 31 couples to a control group. The intervention protocols covered during the four sessions that parents attended are described below.

First prenatal session: Parents were given an instruction manual, and taught about infant sleep patterns (e.g., sleeping through the night, the physiology of infant sleep) and strategies to assist good sleep patterns. These included: (i) establishing a sleep routine early, (ii) allowing the infant to fall asleep alone; (iii) establishing a "focal feed" between 10:00 p.m. and 12:00 a.m.; (iv) discriminating between night and day; and, (v) discriminating infant wakefulness.

Second prenatal session: Parents were instructed in how to help their infant sleep through the night once the infant was "settling-ready" (at least 6-weeks-old, gaining weight, and at least 9 lbs). This step-by-step method involved (i) moving the focal feed to a later time; (ii) lengthening the time before picking up the crying baby; (iii) stretching the time between later night feedings; and, (iv) getting the baby to settle until morning without a feed. When the infants were 6-weeks-old, parents completed 24 hour sleep diaries for 3 consecutive weeks. These were completed again once when the infants were between 16 and 20 weeks of age.

Two post-birth booster sessions: These were held 2 weeks apart when the infants had met the settling-ready criteria. The strategies parents were instructed in during the prenatal sessions were reviewed, and parents could also discuss individual issues, and "ways of improving adherence".

2. Pinilla and Birch (1993). These authors investigated whether exclusively breast-fed infants could be taught to sleep through the night. Thirteen first-time parents were randomly assigned to an intervention group and were instructed in a multi-component parent education package almost identical to that employed by Wolfson et al. (1992). The parents were visited on at least nine occasions in their homes by the researchers, once for a pre-birth home visit, then weekly after the birth of the infant. The intervention protocol implemented during these session is described below.

Pre-birth visit: Parents were provided with a two-page handout and instructed in the components described in Wolfson et al.'s (1992) first prenatal session. Parents were instructed to begin establishing a focal feed earlier than parents in Wolfson et al.'s, study a few days after birth and to begin completing a 72 hour sleep diary weekly, for 8 weeks.

First post-birth visit: The training instructions covered in the first visit were reviewed. During one of the first three home visits parents were instructed in how to lengthen the intervals between feeds when the infants were 3-weeks-old, in good health and steadily gaining weight. Parents were instructed: (i) not to leave the infant alone crying but to attempt alternative interventions to feeding; and, (ii) to offer the infant a feed if he or she continued to cry. These instructions were directed toward the goal of entraining feeding schedules by changing the learned association between awakening and feeding.

3. Adair et al. (1992). These authors aimed to test Ferber's (1985) model of behavioural sleep-onset associations and ISD with 164 parents and their infants. Ferber's model proposed that parents who rock, hold or feed their infants to sleep provide a learned association between parental presence and initial sleep-onset, and these conditions must therefore be present for the infant to fall asleep following a night awakening. The intervention protocol at specific ages is described below.

At 4 months: At an infant health supervision visit, parents were provided with written instructions for providing appropriate proximal cues for sleep-onset. These were: (i) establishing a bedtime routine, (ii) placing the infant into the cot awake, and (iii) leaving the infant to fall asleep without a parent present.

At 5 months: Parents received a daily routine chart for sleeping and feeding which they completed for five consecutive days.

At 6 months: The daily routine chart was discussed with the paediatrician.

Table 5.
Description of preventive intervention programmes

AUTHORS	GOALS/ PARTICIPANTS	MATERIALS	INTERVENTION	PERSONNEL/ SITE	METHOD OF DELIVERY	EXPOSURE TO INTERVENTION /DURATION	AGE	
							AT INTERVENTION	AT MEASUREMENT
Adair, Zuckerman, Bauchner, Philipp & Levenson (1992)	To test Ferber's (1985) model of sleep-onset associations and night waking 168 Treatment 128 Control	One page handouts with advice on sleep and feeding Daily routine charts	1. 4 month visit given handout on putting the infant into crib partially awake, leave to fall asleep on own 2. 5 months daily routine charts mailed 3. 6 months discuss charts	Paediatrician Lahey Medical Centre U.S.	Parents provided with written information discussion with Doctor Questionnaire at 9 months	Two meetings at Medical Centre at 4 and 6 months. 5 months Doctor Questionnaire at 9 months	4 months	9 MO One week diary
Goodlin-Jones, Eiben & Anders (1997)	To test if a sleep aid with maternal odour assists infants in their shift from physiological to social regulation of sleep-wake organisation 11 Treatment 10 Control	T-shirts for the mothers	<u>Expl:</u> Mothers wore T shirt for two weeks and placed it in infant's cot for 12 months <u>Control</u> Unworn T shirt placed in infant's cot for 12 months		One-on-one meeting to explain protocol and study	Meeting prior to intervention Daily phone calls for first 2 weeks	1 month	1, 6, 12 MO 24 hour TLVR
Kerr, Jowett & Smith (1996)	To develop a health education package that could be used by health visitors 86 Training 83 Control	Written material in the form of a health education booklet	When the infants were 3 months-old parents were instructed via written material on settling methods and establishing routines (specific content not described)	Author In the family home	One-on-one researcher and parents	One home visit	3 months	9 MO Interview

Table 5. continued.

AUTHORS	GOALS/ PARTICIPANTS	MATERIALS	INTERVENTION	PERSONNEL/ SITE	METHOD OF DELIVERY	EXPOSURE TO INTERVENTION / DURATION	AT INTERVENTION	AGE AT MEASUREMENT
Pinilla & Birch (1993)	To investigate if exclusively breast- fed infants could be taught to sleep through the night. 13 Treatment 13 Control	Two page handout with written instructions which included all of the content covered in the intervention sessions	Prenatal Session: Same as Wolfson et al. but immediate focal feeding Post Natal session: Same as Wolfson et al. session two. When the infant was 3 weeks old parents to begin lengthening the latency to feeding time. Instructions also in not to leave the infant crying alone, use alternative strategies to feeding such as diapering, swaddling, patting or walking with the infant. At home visits researcher reviewed the protocol was being followed		One-on-one researcher and parent sessions during home visits	Pre-birth home visit. Home visits for 5 consecutive weeks Individual consultation for parents experiencing difficulties.	1 week	Parent report Diary 72 hours a week from birth to eight week
Wolfson, Lacks & Futterman (1992)	Test the efficacy of information regarding the sleep of new-born infants in a self-help book 31 Treatment 29 Control	Manual, handouts 1 session.	Prenatal Session 1: Instructed in infant sleep wake patterns, sleep, STN*, establishing a routine early on, put infant down awake, leave to fall asleep on own, how to establish a focal feed between 10 - 12, how to discriminate wakefulness, differentiate between night and day. Prenatal Session 2: Parents taught step-by-step method to use for 4 nights when infant was at least 6 weeks old, gaining weight, at least 9 lb. To begin to move focal feed to later time, lengthen time before picking up crying baby, stretch time between feeding to be implemented Post natal sessions: Review prenatal material	Clinical Psychology student	Group sessions led by a parent training leader Question & answer periods, group discussion and problem solving	Two prenatal and two postnatal meetings	1 week	Parent report diaries for one week from 6-9 weeks follow-up once at 16-20 weeks

* STN= Sleeping through the night

At 9 months: Parents completed a questionnaire on their infant's sleep behaviours in the preceding week.

4. Kerr et al. (1996). In order to develop a health education package that could be employed by health visitors, these authors tested the efficacy of written material on settling methods and the importance of routine. Eighty-three parents were provided with written material when their infants were 3 months-old. The authors did not describe what strategies parents were instructed in. While they noted that the information was "research-based", they did not cite any references. When the infants were 9 months of age parents were interviewed in order to collect outcome measures.

5. Goodlin-Jones et al. (1997). The conceptual basis of this study was very different from the other preventive studies. They investigated whether an olfactory intervention using a representative sleep aid (a T-shirt impregnated with maternal odour) would assist infants in their transition from physiological to social regulation of sleep-wake organisation over the first year of life. By maintaining cues of maternal proximity the separation processes during sleep-onset, and following an awakening would be eased. These authors suggest that a representative sleep aid would assist in bridging the transition period, and help infants to learn self-soothing behaviours. This would result in more settled sleep patterns. Twelve mothers were randomly assigned to a treatment group where they wore a T-shirt for 2 weeks prior to the infant turning 1 month of age when it was placed in the infant's cot. A regularly replaced worn T-shirt was in the cot for the 12 month duration of the study. The 10 control group mothers placed an unworn T-shirt in their infant's cot for the same duration.

5.1.2. Personnel and Site of Intervention

Two studies described the personnel involved in delivering the intervention (Kerr et al., 1996; Wolfson et al., 1992). No study reported how the personnel were trained. Two studies delivered instruction in the participants homes (Kerr et al., 1996; Pinilla & Birch, 1993), one at a medical centre (Adair et al., 1992), while two did not state where delivery of the intervention took place (Goodlin-Jones et al., 1997; Wolfson et al., 1992).

5.1.3. Method of Delivery

Wolfson et al. (1992) conducted group sessions. During the sessions the participants had the opportunity to be involved in a number of different learning exercises which included question and answer periods, group discussions and problem solving. The remaining studies employed a one-on-one researcher and participant method of delivery.

5.1.4. Exposure to Intervention

There was wide variation among the studies in the extent of the treatment groups' exposure to delivery of the intervention. Similarly, there was wide variation in the amount of contact time with the intervention and control groups. This variation was noted also by Owens et al. (1999) in their review of management studies. Owens et al. stated that

...some of the changes may simply reflect expectation in the group who received more input. Control groups have also received explanation for their involvement that do not give the same sense of active contribution to their child's well being as do those in intervention groups.

(p. 19-20).

Participants in Pinilla and Birch's (1993) study experienced the greatest exposure to instruction of all the studies. The participants had nine home visits. Variations in exposure of delivery between families was not discussed. Contact time between control and intervention groups was identical except for the training instruction sessions.

Treatment group parents in Wolfson et al.'s (1992) study received the next most intensive exposure. Treatment participants met for two prenatal then two post-birth booster group meetings. The control group met for three sessions. Goodlin-Jones et al. (1997) conducted one pre-intervention meeting with the control and treatment participants. The treatment group mothers were informed that the T-shirt would provide the infant with the mother's "signature" odour. Control and experimental subjects spent the same amount of contact time with the researchers.

Participants in the Adair et al. (1992) study meet with the paediatrician on two occasions. The participants did not receive verbal instructions or have their comprehension of the intervention checked as in the other studies.

Intervention participants in the Kerr et al. (1996) study received only one home visit by a researcher who discussed the written materials with the parents. No mention was made of the contact with the control group participants.

5.1.4.1. Adherence

The primary target group in the studies were the treatment group parents, as they were taught how to manage their behaviour prior to, and in response to the infant's behaviour. Adair et al. (1992) and Goodlin-Jones et al. (1997) measured adherence to each component described in their study, Pinilla and Birch (1993) reported on adherence to focal feeding, while Kerr et al. (1996) and Wolfson et al. (1992) did not report any measures. This makes it difficult to establish the degree to which parents adhered, and, therefore, to what extent the infants were actually

exposed to intervention. This lack of evidence prevents establishing concordance between the actual procedure and the intended design.

Except for the measure of focal feeding, Pinilla and Birch (1993) did not measure parental adherence to the other several components of the intervention. The majority of the families did not follow the instructions to focal feed, and despite this Pinilla and Birch (1993) still maintained that "gradual stretching of the night-time feeding and the environmental distinctions between night-time and daytime activities to be influential for the transition to sleeping through the night." (p. 442). However, they did not provide data to substantiate these claims, and therefore no conclusion can be drawn regarding the effects of these components.

Adair et al. (1992), Kerr et al. (1996), Pinilla and Birch (1993), and Wolfson et al. (1992) provided parents with advice on behavioural strategies they could either employ or not employ. Measuring parental adherence makes it possible to identify those components which parents used and those they did not. Further enquiry would assist in identifying the reasons for parental non-adherence or resistance to the components, both would have important implications for future preventive research. A study needs to be evaluated in terms of its social acceptance, complexity, practicality and cost (Cooper et al., 1987). These authors argued that despite the effectiveness of intervention, if the treatment is undesirable to parents they will be unlikely to use it, and progress in the advancement of behaviour change will be prevented. They suggest that the same applies when the independent variables are too complex, too difficult to learn and to teach, and then apply. Only when these issues of social validation are addressed adequately by preventive studies can future research begin to provide effective preventive intervention for ISD.

5.1.5. Measures of Infant Sleep

Goodlin-Jones et al. (1997) was the only study that collected objective measures of infant sleep using TLVR. The remaining studies used prospective parental report diaries (Pinilla & Birch, 1993; Wolfson et al., 1992), retrospective questionnaires (Adair et al., 1992), and interviews (Kerr et al., 1996).

Table 6.
Description of the research methodologies and evidence concerning implementation

AUTHORS	METHOD OF RECRUITMENT	RANDOMISATION	PARTICIPANT ATTRITION	MEASURES OF ADHERENCE
Adair, Zuckerman, Bauchner, Philipp & Levenson (1992)	Clinic medical centre	Prospective cohort design with historical controls	26% training, 26% control	Measured parental presence at sleep onset
Goodlin-Jones, Eiben & Anders (1997)	Local advertisements fliers in doctors' offices	Random assignment		Daily telephone calls for 2 weeks
Kerr, Jowett & Smith (1996)	Letters to parents from the Glasgow Health Board	Random assignment		No measures
Pinilla & Birch (1993)	Local advertisements Obstetrician's office	Random assignment (breast feeding mothers only)		Measured focal feeding
Wolfson, Lacks & Futterman (1992)	Lamaze child-birth classes	Randomised parallel group design	3 training, 4 control couples at follow-up	No measures

5.2. DESCRIPTION OF THE RESEARCH METHODOLOGIES AND ADHERENCE

Table 6 summarises the research methodologies for each study.

5.2.1. Recruitment, Sample Size and Randomisation

Participants were recruited from Medical Centres (Adair et al., 1992; Goodlin-Jones et al., 1997; Pinilla & Birch, 1993), Lamaze child-birth classes (Wolfson et al., 1992) and a Health Board register (Kerr et al., 1996).

Each study had similar numbers of participants in the training and control groups. There was, however, a wide range in the numbers of participants between the studies, ranging from 164 treatment and 128 control group infants (Adair et al., 1992), to 11 treatment and 10 control group infants (Goodlin-Jones et al., 1997).

Wolfson et al. (1992) employed a randomised parallel group design, which according to Coie et al. (2000) is the "gold standard" for the design of prevention research. Goodlin-Jones et al. (1997), Pinilla and Birch (1993) and Kerr et al. (1996) randomly assigned parents to either an intervention or control group. Adair et al. (1992) employed a prospective design with an historical control group.

5.2.2. Baseline Measures and Attrition of Subjects

Each study provided sufficient baseline measures of socio-demographic characteristics, and the health status of the participants. Two studies (Adair et al., 1992; Wolfson et al., 1992) reported rates of attrition, and demonstrated no differences in these families on social or demographic characteristics and those that remained in the study. Kerr et al. (1996) did not report the demographics of participants who were initially recruited, only of those who remained in the study.

5.3. OUTCOMES OF THE PREVENTION STUDIES

The evidence concerning the studies' outcomes is summarised in Table 7. Generally, the results of the majority of the studies are moderately positive in that the infants whose parents participated in treatment demonstrated better sleep patterns than control infants.

Mzarek and Haggerty (1994) state, however, that for a preventive intervention to be evaluated the most fundamental evidence which should be provided is that the risk and protective factors have changed, and that the disorder was reduced or its onset delayed. The method of some of these studies means that these criteria can not be applied. What information is available is summarised below.

Table 7.
Description of evidence concerning outcomes

AUTHORS	CHANGE IN STATUS OF RISK AND OR PROTECTIVE FACTORS	REDUCTION IN NEW CASES/ DELAY OF ONSET OF DISORDER
Adair, Zuckerman, Bauchner, Philipp & Levenson (1992)	67% of parents not present at sleep onset at 9 months	1. Control infants had fewer night wakings 2. 14% of intervention group had frequent night awakenings
Goodlin-Jones, Eiben & Anders (1997)	Increased sense of maternal psychological well-being	
Kerr, Jowett & Smith (1996)		1. 21% of treatment infants had settling difficulty vs. 39% control infants 2. Treatment infants had significantly fewer night awakenings per week and per night
Pinilla & Birch (1993)	Longer LUSP at 3-8 weeks. At 8 weeks all of these infants were sleeping through the night.	Only from 3 to 8 weeks No outcome measure post 8 weeks
Wolfson, Lacks & Futterman (1992)	Significantly more young infants were sleeping for >300min Significantly more young infants had fewer awakenings Parents reported fewer hassles	Only from the ages of 6-9 weeks, not evident at 16 weeks. No outcome measures post 5 months

Wolfson et al. (1992) and Pinilla and Birch (1993) collected their outcome measures prior to 6 months, the defining age for ISD. It is not possible, therefore, to ascertain whether the intervention reduced new cases or delayed the onset of primary ISD. However, there were short-term changes in certain risk factors in both studies. In Wolfson et al.'s study these changes involved significantly more treatment infants sleeping through the night, sleeping for longer bouts, and having fewer awakenings than the control infants. Parents of the treatment infants reported a greater sense of competence compared with the control parents. These gains, however, were not maintained at follow up.

When treated infants in Pinilla and Birch's (1993) study were 4-weeks-old, 48% were reported to be sleeping through the night. By 8 weeks of age this rate increased to 100%, compared with 23% of the control infants. These authors did not collect follow-up data, so it is unknown whether these gains in the treatment group were maintained at least to 6 months. Pinilla and Birch (1993) employed Moore and Ucko's (1957) definition of sleeping through the night. There are serious methodological and conceptual problems with this definition which are described in Chapter Six. For example, studies show that 2-month-old infants can sustain a sleep period for 6.2 hours (Anders & Keener, 1983) which is longer than Moore and Ucko's 5 hour duration.

Adair et al. (1992) failed to demonstrate a decrease in the parent risk factors of presence at sleep-onset, and placing the infant into the cot awake. The rate of ISD for infants aged 9 months, as defined by frequent night awakening, is reported to range between 23% and 28% (Adair et al., 1992; Anders, 1979; Hewitt et al. 1989). Adair et al. therefore demonstrate a reduction of new cases and delay of onset of ISD, as 14% of treated infants were waking frequently.

Given there is no decrease in parental risk factors, it is unclear which factors could account for the differences in night awakenings between the two groups in Adair et al.'s (1992) study. Repeated measures of parent behaviours for the duration of the study may have assisted in identifying the reason. One hypothesis is that a significant number of parents implemented the intervention when the infants were younger resulting in more settled sleep patterns, but that outcome measures were collected at the age when separation anxiety is at its most intense (France & Blampied, 1999). Parents may have remained with the infant until sleep-onset in order to soothe and reassure a distressed infant who became anxious and fretful when the parent attempted to leave the room. One would expect these associations to be reflected in increased awakenings. Possible reasons for why this was not the case include: infants may have self-initiated sleep following an awakening and did not need a parent to attend in order to resume sleep; or, that a number of infants did not experience

complete arousals and fully awaken; or, the parents did not tend to the night awakenings and reinforce the infants crying upon awakening.

Kerr et al. (1996) only reported outcome measures for sleep variables, so any change in parent risk factors could not be established. Compared with the control infants significantly fewer infants had settling difficulties at sleep-onset, were waking for 2 or more times a night (23% treatment vs. 46% control), and awakened 4 nights a week. Twenty-three percent of their infants woke twice a night, however. This figure falls well within the range for ISD at this age. This suggesting there was no change in the number of cases, or delay in onset of ISD. Moreover, a mean of 2 nights awakenings per week would have meet several authors' criteria for ISD in infants at a similar age (Jenkins et al., 1980; Moore & Ucko, 1957; Richman, 1981; Van Tassel, 1985; Werry & Carlielle, 1982).

Despite this, Kerr et al. (1996) did report a reduction in new cases and a delay in onset, but this was because they used the extremely high bench-mark figure for ISD of 42%. This figure was cited as being derived from Galbraith et al. (1993). This figure is unacceptably high and distorts the apparent results of the study. It is too high because Galbraith et al., who in turn derived this figure from Hewitt et al. (1989), reported it wrongly. Hewitt et al. reported a much lower rate of infants awakening frequently and causing parental concern. Consequently, Kerr et al. use a bench-mark figure almost twice as high as is used in other prevalence studies for 9-month-old infants (Adair et al., 1991; Anders, 1979). Kerr et al. (1996) did not collect baseline or follow-up data.

Because baseline data was not collected, it is unclear whether the Kerr et al. (1996) and Adair et al. (1992) studies investigated preventive intervention or in fact investigated *management* interventions with older infants, some of whom would have already been sleep-disturbed. Baseline measures collected prior to the intervention respectively at 3 and at 4 months of age, would have established whether the infants were already evidencing disturbed sleep behaviours, and/or whether the parents were already employing any of the intervention components in an attempt to manage their infant's sleep. By comparing baseline data with the outcome data it would have been possible to ascertain whether parents: (i) changed their behaviours and implemented the behavioural strategies; (ii) were already engaging in the strategies; or (iii) never implemented the behavioural strategies. This would have provided more information about the effects of appropriate stimulus control at sleep-onset, particularly when the same components of stimulus control have been empirically validated as a successful *management* technique for ISD (France & Hudson, 1990), and with infants of the same age (MacGarr & Hovell, 1980).

Table 8.
Behavioural principles as components of preventive interventions

AUTHOR	INSTRUCTION IN STIMULUS CONTROL OF SLEEP ONSET	INSTRUCTION IN REINFORCEMENT	INSTRUCTION IN EXTINCTION	INSTRUCTION IN THE PERB
Adair, Zuckerman, Bauchner, Philipp & Levenson (1992)	Bedtime routine Place infant in cot partially awake, and alone	No	No	No
Goodlin-Jones, Eiben & Anders (1997)	No	No	No	No
Kerr, Jowett & Smith (1996)	Discussed settling methods and routines	No	No	No
Pinilla & Birch (1993)	Establish a sleep routine early on Differentiated between night and day Parental presence not required for sleep onset	Parents to engage in alternate behaviours to feeding the infant	No	No
Wolfson, Lacks & Futterman (1992)	Establish a sleep routine early on Differentiated between night and day Parental presence not required for sleep onset	Parents instructed to lengthen time before picking up crying infant, allowing infant time to self-soothe	No	No

There was no difference in sleep architecture between the treatment and control group infants in the Goodlin-Jones et al. (1997) study. They did, however, report an increase in the protective factor of mothers' sense of well-being.

5.4. USE OF OPERANT PRINCIPLES BY THE PREVENTIVE STUDIES

From the management literature, the principles of operant behaviour theory (described in Chapter Five) were employed to clarify the contribution of parental behaviours in maintaining ISD. These findings have important implications for prevention because the contributing parental behaviours are amenable to alteration, and can be targeted as components for preventive intervention. Hence, it enabled predictions to be made regarding how the findings of the management literature could be extrapolated to preventive intervention. As shown in Table 8 the preventive studies are summarised according to whether parents were instructed in the behavioural principles of stimulus control, reinforcement (immediacy of parental responses, intensity of parental responses, consistency in parental responses), extinction (decreasing parental attendance, withdrawing parental reinforcing behaviours, consistency in extinction procedures), and the PERB. The findings are as follows:

1. Instruction in stimulus control. Except for Goodlin-Jones et al. (1997), the remaining studies employed this technique as a component. Adair et al. (1992) instructed parents to place the infant down awake, and not be present at sleep-onset. Wolfson et al. (1992) and Pinilla and Birch (1993) also instructed parents to allow the infant to fall asleep alone and to establish sleep routines. It could not be established which elements of stimulus control Kerr et al. (1996) advised parents to employ.
2. Instruction in the power of reinforcement: Wolfson et al. (1992) was the only study to employ this component by instructing parents to allow the infant time to self-soothe before attending. Thereby parents are not providing immediate reinforcement to the infant's crying upon awakening behaviour. Pinilla and Birch (1993) instructed parents to engage in alternative behaviours to feeding the infant upon awakening. These alternate behaviours do not reflect a change in the immediacy, nor the intensity of parent behaviours that could reinforce and maintain the infant's awakening behaviours.
3. Instruction in extinction: No study employed this component.
4. Instruction in the PERB: No study employed this component.

The most common operant behavioural principle employed by the prevention studies was stimulus control. Parents were instructed to provide appropriate cues for sleep self-initiation in the Adair et al. (1992), Wolfson et al. (1992) and Pinilla and Birch (1993) studies. Except for Wolfson et al. the remaining studies generally ignored the principles of reinforcement, extinction, and the PERB. Perhaps this is not surprising given Adair et al. was the only study to specifically state a behavioural principle in its rationale. Of the remaining studies, only Wolfson et al. made reference to the efficacy of behavioural management studies in her introduction.

5.5. SUMMARY

1. The five prevention studies considered varied in the duration of and, exposure to intervention, the developmental stage of implementation, the intervention techniques employed, and the outcome measures used.
2. Generally the studies employed a multi-component parent education programme containing elements of stimulus control and modifying feeding schedules.
3. Pinilla and Birch (1993), and Wolfson et al. (1992) demonstrated that very young infants could achieve consolidated sleep patterns. These findings were not translated into long term benefits. Treated infants in the Adair et al. (1992), and the Kerr et al. (1996) studies had fewer night awakenings compared with control infants. There were no differences between the sleep-state architecture of treatment and control infants in the Goodlin-Jones et al. (1997) study.
4. Pinilla and Birch (1993), and Wolfson (1992) demonstrated short-term changes in infant and parent risk factors. Only Adair et al. (1992) demonstrated a reduction in new cases and delay in onset of ISD.
5. There is insufficient evidence concerning parental adherence to intervention. This prevents true evaluation of the preventive programmes.
6. Pre-existing differences between groups on parent and infant sleep behaviours were not investigated by Adair et al. (1992) or Kerr et al. (1996). The outcome measures did not ascertain if infants were sleeping through the night, nor was there was any follow-up.
7. Stimulus control during sleep-onset was the most common technique parents were instructed in.
8. Decisions regarding when to intervene were not based on developmental findings. The optimal time developmentally for prevention is unclear.
9. Which variables should be manipulated and how remains unclear.
10. Future studies need to ensure that outcome measures of primary and secondary ISD are included.

5.6. CONCLUSION

To date, the efficacy of the prevention intervention for ISD in studies is inconclusive. This is due to the lack of theoretically sound conceptual frameworks and conceptual clarity in the planning of preventive intervention resulting in a lack of: (i) follow-up data for primary and secondary ISD; and (ii) risk factors, new cases and the onset of delay being measured. These studies are new to the area of infant sleep, and prevention research is still in its "infancy". It is unsurprising then that review of these studies has yielded more questions than answers. In particular, three central theoretical and practical issues require careful consideration by future research, these include:

1. The optimal time developmentally for preventive intervention remains unclear. The interventions began at different developmental stages. This demonstrates the lack of a theoretical or empirical basis for decisions on when is the optimal time to intervene. When to intervene requires careful consideration given the momentum at which infant sleep patterns develop in the early months. It is therefore necessary to examine normative development of infant sleep. This will serve to identify the age infants when first begin to sleep through the night, and the age when the majority of infants are sleeping through. This information will help would identify a developmental period when infants are physiologically and behaviourally ready for preventive intervention.
2. The second issue is what components should be employed for preventive intervention and how should it be conducted? Should a multi-component treatment "package" be employed, or should specific variables be individually manipulated? It is unclear which method is more efficacious and which parent variables should be manipulated. What is clear, is that intervention must focus on the key parent behaviours that antedate and are predictive of ISD. Explanatory models of ISD describe the interaction of environmental (parent) and constitutional factors and their influence on the development of sleep patterns (France & Blampied, 1999). Chapter Seven examines the models of ISD and their implications for prevention.
3. Finally, there is a need to establish optimal outcome measures in primary and secondary ISD. Short term of changes in the sleep patterns of very young infants are simply, not a sufficient measure of ISD. Neither are mean differences in night awakening between a treatment and control group. Measures must at least include sleeping through the night the major aim of preventive intervention. A global,

diagnostic measure is also desirable. The SBS (Richman, 1981) for example would indicate whether an infant was evidencing a disturbed or settled sleep pattern.

CHAPTER SIX

DEVELOPMENTAL PROCESSES IN INFANT SLEEP

Prevention should be based on appropriate developmental tasks (Mzarek & Haggerty, 1994) which in this case is sleeping through the night. This is in order for prevention to be designed in synchrony with normative developmental processes (Coie et al., 2000). In order to reduce the onset of ISD, primary prevention needs to be targeted at a particular point in the developmental process towards sleeping through the night. It is necessary to investigate the normative progression towards completing this task because at this point in time, the developmentally optimal time for primary preventive intervention, remains unclear.

Longitudinal studies investigating the normative development of infant sleep are reviewed below to establish when infants are most likely to sleep through the night. Establishing the developmental history preceding this goal would identify when infants are physiologically and behaviourally "ready" for preventive intervention. However, this is likely to be difficult:

It is still not clear what infants should be doing and when, and what is the normal range of individual variation.

(Sadeh & Anders, 1993, p. 31)

Despite this knowledge of the patterns of change in the early years of life, there are still major gaps in our knowledge of even the most fundamental qualities of infant and toddler sleep. Thus when attempting to characterise whether sleep in toddlers is following a normative or deviant developmental path, there are only fuzzy guidelines to assist the researcher in making appropriate attributions.

(Seifer, Sameroff, Dickenson, Hayden & Schiller, 1996, p. 717)

Before reviewing the research to establish infants' progressions in sleeping through the night, it is necessary to describe infants' preceding developments in sleep-state organisation, and their emerging diurnal periodicity. The literature on the development of infant sleep-state organisation is examined to identify if any infant characteristics contribute towards resilience (protective factors), or vulnerabilities (risk factors) to developing a disturbed sleep pattern. The first section of this chapter therefore, aims to review the literature on the development in infant sleep-state organisation, and the emergence of the diurnal cycle.

The second section of this chapter reviews the empirical research to establish when infants first begin to sleep through the night. There are two main approaches to defining this variable:

1. Examining infants physiological and behavioural capabilities for durations of consolidated sleep. The Longest Sleep Period (LSP) defines the infant's *physiological* capability for continuous sleep. Operationally, measurement of the LSP is terminated when an infant transitions to wakefulness (Anders et al., 1983; Anders & Keener, 1985), and is measured by direct observation. In contrast, The Longest Uninterrupted Sleep Period (LUSP) is the infant's *behavioural* capability for continuous sleep. Operationally, measurement of the LUSP measures behavioural quietude. It therefore includes both sleep, and transitions to wakefulness that are followed by sleep self-initiation. The LUSP is typically measured by parent report.

2. Some researchers have determined specific time durations as criteria for defining "sleeping through the night". These studies typically employ parent report.

6.1. THE DEVELOPMENT OF SLEEP-STATE ORGANISATION

The marked differences between the sleep-wake patterns of infants and adults have been well documented (see Anders, Sadeh & Appareddy, 1995; Wolfson, 1996). During the first year of life, infants' sleep-wakes states and the regulation of sleep patterns undergo rapid developmental change so they begin to approximate the sleep patterns of adults. The following section describes how the development of sleep-wake state organisation is influenced by two process that mature during very early infancy (Sadeh & Anders, 1993): first, the ultradian organisation which refers to the 60 - 90 minutes periodicity's that regulate sleep states of REM (Rapid Eye Movement) and NREM (Non-Rapid Eye Movement) sleep cycles; and second, the diurnal organisation involves more continuous sleep and less feeding during the night, and more wakefulness and feeding occurs during the day (Sadeh & Anders, 1993).

6.1.1. The Ultradian Organisation of the REM/NREM Cycle

Ultradian organisation involves organisation of REM sleep and NREM (Sadeh & Anders, 1993). "REM sleep is defined by a low voltage, fast, desynchronised electroencephalogram (EEG); bilaterally synchronous, rapid eye movements under closed lids; rapid and irregular heart rate and respiratory patterns, and muscle atonia." (Anders et al., 1995, p. 9). While NREM sleep "is characterised by high voltage slow waves in the EEG, slowed regular cardiac and respiratory rates and resting levels of muscle tones." (Anders et al., 1995, p. 9). The relative proportion of REM to NREM, is considered an indicator of maturation. Decreased amounts of REM sleep are a critical indicator of central nervous system development (Wolfson, 1996).

In very young infants a further state, called indeterminate or transitional sleep, can be identified. This state is coded when the states of REM and NREM are

disorganised (Anders et al., 1995) and reflects immaturity or "undifferentiation" in sleep-state organisation (Emde & Walker, 1976). The proportion of indeterminate sleep decreases rapidly during the early neonatal period as the NREM and REM states become better co-ordinated and more organised (Anders et al., 1995). It is unclear exactly when indeterminate sleep ceases.

There are a number of differences in the organisation of sleep-states between adults and infants that are generally accounted for by maturation. NREM sleep has been described as a more mature pattern of sleep (Hoppenbrouwers, 1987). Adults enter sleep-onset in NREM and have a greater proportion of NREM sleep: 20% REM: 80% NREM (Anders et al., 1995). In contrast neonates begin sleep-onset in REM, and have an equivalent sleep-state proportion of 50% REM: 50% NREM which is spread throughout the night. Infants also have shorter periodicity's of sleep-states than adults, with cycles every 50-60 minutes, while adults cycle every 60-90 minutes (Ferber, 1985). By 3 months of age infants begin to enter sleep-onset in NREM (Sadeh & Anders, 1993), and the proportion of REM sleep has significantly decreased (Anders et al., 1992; Hoppenbrouwers, 1987). By 8 months infants' sleep consists of one third REM (Hobson, 1989), and the REM/NREM periodicity's of 50-60 minutes remain the same.

A further developmental change is the amount of REM over the course of the night and the proportion of NREM/REM within sleep cycles during the day and at night. In each cycle the amount of REM begins to shift over the course of the night, so it occurs in the later sleep cycles of the night, similar to that of adults' sleep. Studies have found that infants experience more NREM sleep during the nocturnal hours and less REM during the day as early as in the first 2 days post-birth (Sadeh, Dark & Vohr, 1996), and at 2 months (Schechtman, Harper & Harper, 1994). Some very young infants therefore have the physiological capability to experience mature sleep-state organisation during the nocturnal hours in early infancy, which lessens the vulnerability to frequent night awakenings.

6.1.1.1. Complete and Partial Arousals

Infants awaken frequently throughout the night as both REM and NREM sleep are interrupted by brief arousals. These arousals are most frequent between the ages of 3 to 6 weeks, and may increase in frequency and duration as the night progresses. The durations range from seconds to minutes, and their frequency decreases with cerebral maturation (Zaiwalla & Stein, 1993). Arousals occur for less than 5% of the night (Carskadon et al., 1988). By TLVR and actigraphic monitoring of infants aged 2 and 9 months, it was determined on average, infants' experienced one or more arousals per night with a mean duration of 1-5 minutes (Anders, 1979; Sadeh et al., 1991).

After 4 months of age the majority of infants experience a spontaneous awakening after 6-7 hours of continuous sleep (Anders et al., 1992).

Ferber (1985) describes two types of arousals: "partial arousals", and "complete arousals". A partial arousal typically occurs during NREM sleep, at the end of two cycles of deep sleep and before entering lighter NREM sleep. During the course of a partial arousal the infant seems unaware of experiencing wakefulness and resumes sleep without intervention. A complete arousal occurs during or at the end of REM sleep. The infant will fully awaken, and will either resume sleep unassisted, or signal and require parental intervention for resumption of sleep. Hence, most infants awaken during REM episodes, and because of the high frequency of REM sleep, which precedes awakening, infants are vulnerable to waking regularly (Blampied & France, 1999).

6.1.2. Diurnal Organisation of Infant Sleep: Regulation of the Sleep-Wake Cycle

Diurnal organisation refers to the circadian sleep and wake cycle of about 24 hours periodicity. It has been described as "a shift from multiphasic sleep distributed across the day and the night to a monophasic event of consolidated sleep concentrated during the dark hours of the night" (Sadeh, Raviv & Gruber, 2000, p. 291). It is therefore one of the first approximations towards the development task of sleeping through the night. Ferber (1985) claims that awakenings in the early months can be attributed, in part, to the fact that a diurnal periodicity has not been established.

6.1.2.1. The Diurnal Cycle: Maturation vs. the Environment

Amongst researchers in the field there are differences regarding what is judged to have the greatest influence on the development of the diurnal cycle. Coons and Guilleminault (1984) claimed that maturation has the greatest influence. They stated that a diurnal cycle occurs when the cyclicity or alternation of sleep states is "organised" or "stable". They found random sequencing at 3 and 6 weeks, which had stabilised at 3 months. Other studies have reported stability at earlier ages, as early as 36 weeks gestational age (Stern, Parmelee & Harris, 1973), and across the first five post-natal weeks (Thoman & Whitney, 1989).

Empirical evidence suggests the environment also influences the diurnal cycle of very young infants (McMillen, Kok, Adamson, Deayton & Nowark, 1991; Sadeh, Dark & Vohr, 1996; Sander, Stechler, Burns & Julia, 1970; Schechtman, Harper & Harper, 1994; Sostek, Anders & Sostek, 1976). Sander et al. found that newborn infants who had regular 4-hourly feedings in the first 10 days in a hospital nursery, exhibited earlier patterns of diurnal wakefulness and nocturnal sleep, compared with infants who were fed on demand and roomed in with a caregiver. They attributed the routine and the environmental cues from the infants' nursery experience as responsible

for entrainment of the 24-hour rhythm. Anders and Keener (1985) arrived at the same conclusion to explain why premature infants had a higher percent of LSP during the night at 2 and 4 weeks of age compared with full-term infants (matched for conceptual age). Thoman and Whitney (1989) found significant diurnal patterns in infants from 2 weeks of age, and concluded that from birth infants are capable of entraining their sleep to environmental cues.

The evidence provided by researchers suggests that the environment has a greater influence on emergence of a diurnal cycle than maturation. Both of these factors interact to influence emergence of a diurnal cycle, and Sadeh and Anders (1993) describe the interaction as infants become older:

...the internal biological "clocks" become co-ordinated with regularly recurring environmental zeitgebers which include the light/dark cycle, ambient temperature/noise changes, and regularly scheduled periods of social interaction, and internal body signals such as hunger, pain, core temperature, and hormone secretion.

(p. 11)

6.1.2.2. Emergence of the Diurnal Cycle

There are divergent findings in the literature regarding the age when a diurnal cycle first emerges and shows stability. This may be due to an historical effect, as earlier studies suggested it emerged as late as 12 weeks (Anders & Keener, 1985; Coons & Guilleminault, 1984; Hoppenbrouwers, 1987; Kleitman & Engelmann, 1953; Moore & Ucko, 1957; Parmelee et al., 1964). In contrast recent studies have reported a diurnal pattern as early as 2 days post-birth (Sadeh et al., 1996), by 6 weeks (St-James, et al., 1996; Thoman & Whitney, 1989; Whitney & Thoman, 1994), or by 2 months of age (Fukuda & Ishihara, 1997; Michelsson et al., 1990; Sostek et al., 1976).

6.1.3. Summary of Sleep-State Organisation

1. Sleep-states of young infants are immature and disorganised, and not as well demarcated as the sleep-states of adults. The changes during the early months are quite rapid.
2. From birth, infants who experience more NREM during the night are physiologically predisposed to having a more mature sleep pattern.
3. NREM sleep is an important marker of maturation and is associated with complete arousals.
4. The frequency of REM episodes makes infants vulnerable to frequent arousals which may result in awakenings during the night.
5. Establishing a diurnal cycle is one of the first approximations towards sleeping through the night.

6. There is sufficient evidence to demonstrate that diurnal cycles are typically established by the age of 2 months.
7. Both maturation and the environment influence the establishment of a diurnal cycle. The balance of evidence suggests that environment has a greater influence on diurnal pattern than maturation. This has important implications for prevention intervention.

6.2. "SLEEPING THROUGH THE NIGHT": THE CONSOLIDATION OF INFANT SLEEP-WAKE PATTERNS

There is a developmental progression of the consolidation of infant sleep-wake organisation that begins from birth and extends through infancy. Very young infants sleep for a total of 16 out of 24 hours (Parmelee et al., 1964) and during this period, sleep is multiphasic and is evenly distributed. As infants develop a diurnal cycle their period of longest uninterrupted sleep begins to consolidate so that they are sleeping through the night. There are several concurrent but different approaches to researching these changes. This area of research is difficult to synthesise, and directly compare owing to differences in measures, definitions and methodology. Hence, this review is organised according to four different approaches to measuring the consolidation of infant sleep patterns. The literature is reviewed to establish quantitative changes in the development of uninterrupted periods of sleep. Because each approach represents a different effort to better understand the development of infant sleep it was necessary that three separate reviews be conducted. These included: (i) the LSP, (ii) the LUSP, (iii) sleeping through the night as defined by investigators.

Studies had to meet the following criteria to be included in the review: (i) measures had to be presented at more than one age in the first 12 months; (ii) the infants were not selected because of specific sleep pattern development or developmental status (e.g., infants with, or without sleep disturbance, or with abnormal developmental presentations); and, (iii) the infants were developing normally. Due to the small number of studies that could be located, data from control groups of two experimental studies were also included (Pinilla & Birch, 1993; Wolfson et al., 1992). The data from the Pinilla and Birch study was estimated from their graph. This may have resulted in a small amount of error.

Table 9.
The Longest Sleep Period (LSP) in minutes from direct recording.

AUTHORS	DESIGN/ N	RECORD/ DURATION	LSP BY PARTICIPANT AGE IN MONTHS							
			<1	1	2	3	4	5	6	12
Anders, Halpern & Hua (1992)	Longitudinal n=21	TLVC 1 night		215.0		358.0				
Anders & Keener ¹ (1985)	Longitudinal n= 40 at <1,1,2,5, n= 39 at 6,9,12	TLVC 1 night	233.0	270.0	371.0		436.0	423.0	446.0	403.0
Anders, Keener, Bowe & Shoaff (1983)	Longitudinal n= 40 at <1, 2 n= 39 at 2,5,6 n= 19 at 9, 12	1. TLVC 1 night	232.0	269.0	376.0		439.0	423.0	449.0	412.0
Coons & Guillemineault (1982)	Cross-sectional n= 10 at >1, 2, 4, 5 n= 9 at 3, 6	EEG 24 hrs 2 to 3 nights	211.7	248.2		383.2	386.1		358.2	
Goodlin-Jones, Eiben & Anders (1997)	Longitudinal n=21	TLVC 2 nights		194.0					333.0	335.0
Halpern, Anders, Garcia Coll & Hua (1994)	Longitudinal n=21	TLVC 12 hrs		210.1		357.6				

Note. ¹ = full-term infants only

6.2.1. The Longest Sleep Period (LSP)

From earlier studies Anders and Keener (1985) found the variable of total sleep time (TST) over 24 hours was not a sensitive enough measure of infant sleep-wake development. They created a new and more relevant measure called the LSP. This is a more sensitive measure of sleep maturity compared with the TST, and is considered an indicator of disturbed sleep. The LSP was defined as the "longest total continuous time that infants remained asleep without transitions to wakefulness or out of the crib" (Anders et al., 1983, p. 155). The LSP can only be measured accurately by direct recording and not by parent report. This is because parents are not necessarily aware when infants awaken and self-initiate sleep. Measurement of the LSP is terminated when an infant awakens. The results of studies considering this variable are summarised in Table 9.

6.2.1.1. Duration and Distribution of the LSP

As shown in Table 1 the greatest increments in duration of the LSP occurred across the first 4 months. The findings of the studies are remarkably consistent. At 2 to 3 weeks the LSP was slightly less than 4 hours. It increased to 6.2 hours at 8 weeks, then to more than 7 hours at 5 months. This duration remained relatively stable though to 12 months of age. Goodlin-Jones et al. (1997) reported the shortest durations, but the proportional increase across ages was similar to that of other studies.

Only Coons and Guilleminault (1982) reported the location distribution of the LSP distributed over the 24 hour period. They found that by 6 weeks, the LSP was no longer randomly distributed, and was predictably located in the nocturnal segment of the diurnal period, i.e., between 8:00 p.m. and 8:00 a.m. hours. At 3 weeks of age the majority of infants were having the LSP during this same nocturnal period.

6.2.1.2. Methodological Considerations

6.2.1.2.1. Short measurement periods

The majority of studies collected only one night of data at each age of measurement. While direct observations are the "gold standard" for measurement (France, 1989), the reliability of single recordings are questionable given the variability in infant behaviour, and single recordings do not always represent the typical pattern of the infant's sleep (Anders et al., 1985; Barr & Desilets, 1996). This may explain why Goodlin-Jones et al. (1997) who collected data on two successive nights reported the shortest durations in the LSP.

6.2.1.2.2. Lack of generality of the results

It is disappointing that so few studies could be located for this review. Each of these few studies had a small number of subjects, so it is difficult to generalise the findings. Had Anders and colleagues (Anders et al., 1983; Anders & Keener, 1985; Anders et al., 1992; Goodlin-Jones et al., 1997; Halpern et al., 1994) collected measures at more ages, then it would have allowed for a more sensitive set of developmental data to demonstrate the age-related changes in the LSP.

6.2.1.3. Why the LSP is Insufficient

On its own the LSP is not a sufficient measure to demonstrate when the majority of infants begin to sleep through the night. It does provide a foray of the "ecology of the night" (Anders et al., 1983) in that it shows how infant sleep consolidates and when. However more information is required. The LSP is a one physiological measure of infant sleep, and does not represent the chain of behaviours that comprise sleeping through the night. Sleeping through is a very complex phenomenon because it does not mean sleeping without awakening (Anders, 1979). For example, Anders and colleagues (Anders, 1979; Anders et al., 1983; Anders et al., 1992; Halpern et al., 1994), and Minde et al. (1993) found that while some infants awakened, signalled and required parental attendance for resumption of sleep, those without sleep problems either self-initiated sleep or did not awaken at all through out the recording period. Hence, sleeping through involves one LSP, or a number of LSPs which are interspersed by quiet arousals with awakenings.

A holistic picture of the developmental progression in the sleep consolidation would reflect both the infants' physiological capabilities of the LSP, and their behavioural capabilities maintaining behavioural quietude on sleep self-initiation following a complete arousal (i.e. the LUSP).

6.2.2. The Longest Uninterrupted Sleep Period (LUSP)

Throughout the night infants experience a number of arousals, some which are accompanied by awakenings. If parent report is used as a measure, infants who self-initiates sleep following an awakening appear to be sleeping for longer durations, than if the LSP is measured by direct observation. The LUSP therefore, is defined as the total continuous time that infants sleep uninterrupted without any signalling. It includes the LSP and behavioural quietude during complete arousals which are not evident to parents. Generally, measurement of the LUSP has been confined to the earliest studies investigating infant sleep (Parmelee, Schulz & Disbrow, 1961; Parmelee et al., 1964; Traisman et al., 1966). Because of the behavioural nature of ISD the LUSP serves as a better indicator of whether an infant's sleep pattern is disturbed

Table 10.
The duration (hours) of the Longest Uninterrupted Sleep Period (LUSP) during infancy.

AUTHORS	DESIGN/ N	SOURCE	NIGHT DEFINED:	RECORD/ DURATION	<1	1	2	3	4	5	6	7	9	10	11	12	18	24
Elias, Nicolson, Bora & Johnston (1986)	Longit'l	Not stated	8:00 p.m. to 6:00 a.m.	Sleep Logs Interview 24 hours			6.5		8.0			6.7		7.3				
Jacklin, Snow, Gahart & Maccoby (1980)	Longit'l	General Hospitals	None	Sleep Logs 24 hours							8.8		9.3			9.5	9.9	9.6
Parmelee, Wenner & Schultz (1964)	Longit'l Short term Prospective	University Colleagues & Medical Students	7:00 p.m. to 7:00 a.m.	Sleep Logs 15 min blocks 1 week	WK ¹ 1:4.0 2:4.4	4.6	6.4	7.6	8.4									
Parmelee, Schultz & Disbrow (1961)	Short term Prospective Descriptive	University Colleagues & Medical Students	None	Sleep record 3 days	Day ² 1:4.8 2:4.2 3:4.5													
Pinilla & Birch (1993)	Experim't'l	Obstetricians	Midnight - 5:00 a.m.	Sleep and feeding Diary 72 hours 1 x for 8 weeks	WK 1:2.8 2:2.9 3:3.0 4:2.5	WK 6:2.8 7:3.5	3.6											
Traisman, Traisman & Gatti (1966)	Longit'l Prospective	General Pediatric Practice	None	Parent interview		5.5	8.7	10.5	11.3	11.5	11.6		11.8		11.9	11.9	13.8	
Wooding, Boyd & Geddis (1990)	Cross'l	Plunket Nurses	Unbroken sleep	Sleep Diary Questionnaire Six days		8.2			10.2						11.3			
Wolfson, Lacks & Futterman (1992)	Randomised Parallel Group Design	Lamaze Antenatal Classes	None	Sleep Diary 24 hours 3 weeks Follow-up 16 -20 wk		5.1	WK 8:5.3 9:5.5		6.7									

Note: ¹ age in weeks ² age in days

or not than the LSP. Longer LUSPs indicate more settled sleep, while LUSPs of short durations demonstrate less settled sleep because they are punctuated by signalling and awakenings that may require parental attention.

The results of studies which have investigated this variable are presented in Table 10.

6.2.2.1. Duration and Distribution of the LUSP

As shown in Table 10 the greatest increment in the duration of the LUSP occurred in the first 4 months. From 5 to 12 months, there was minimal increment in the duration of this measure. Studies that provided data from 1 to 4 months demonstrated a two-fold increase in the LUSP (Parmelee et al., 1961; Traisman et al., 1966). The most rapid increase was from birth (range 2.5 to 4.8 hrs), to 2 months (range 5.3 to 8.8 hrs). By 4 months, except for Wolfson et al. (1992), the remaining studies reported durations longer than 7 hours. An increase of this magnitude was not repeated across any other age period in infancy. The few studies that reported figures from 6 to 12 months demonstrated a small but gradual increase in the LUSP (Jacklin et al., 1980; Traisman et al., 1966). No study investigated the distributions of LUSP over the first year.

At each age in the first six months, there was a consistently wide range in the figures presented across studies. This range is explicable for two reasons. First, Pinilla and Birch (1993) located the LUSP between midnight and 5:00 p.m. so the maximum LUSP was only 5 hours. Hence, they presented the minimum figures for the first 3 months. Second, Traisman et al. (1966) reported LUSPs by 2 to 3 hours longer than other studies at each age point. This may be explicable given they were based on retrospective recall. Information on the infants' sleep patterns was embedded in questions regarding his/her general health during parent interviews. Parents did not complete records of the infants' sleep patterns. Its accuracy is therefore questionable.

6.2.2.2. Methodological Considerations

Given the large number of studies that have investigated the development of infant sleep, systematic review has yielded surprisingly few studies that described the developments of the LUSP. The majority were conducted over 30 years ago, and the data from contemporary studies had to be obtained from control groups in experimental studies (Pinilla & Birch, 1993; Wolfson et al., 1992) and one cross-sectional study that presented data at only three age points in the first 12 months (Wooding et al., 1990). One possible explanation is that a number of descriptive studies investigating the development of infant sleep have reported figures for total

time asleep at night rather than the LUSP (e.g., Armstrong et al., 1994; Kleitman & Engelmann, 1953; Scher, 1991).

6.2.2.2.1. Studies of the *first 4 months*

The figures show that infants experience the most rapid and sustained increase in their LUSP in the first 4 months. However the lack of studies, and the lack of repeated measures makes it difficult to establish the exact changes in the durations, and to identify the age when the most rapid progressions occur. These factors would assist further in establishing the timing for prevention. Data was provided by one study for the first 3 post-natal days (Parmelee et al., 1964), and by another study for the first 3 months (Pinilla & Birch, 1993), and two studies presented data at 4 months (Parmelee et al. 1964; Traisman et al., 1966). These latter studies are both old and have a number of methodological problems.

Studies located the LUSP within varying time periods making it to difficult to compare the studies' findings. This in turn, makes it difficult to establish the magnitude of change in duration from 1 to 4 months. For example, Parmelee et al. (1964;1961) located it over the entire night, while Pinilla and Birch (1993) located it in less than half of this period. This may explain in part, why two studies reported an increase of between 2 to 3 hours (Parmelee et al., 1964; Traisman et al., 1966), and two studies reported an increase of less than 30 minutes (Pinilla & Birch, 1993; Wolfson et al., 1992).

6.2.2.3. Lack of Data at Specific Age Points

Not one study presented data at each month in the first 12 months. Of the eight studies reviewed two provided data at four ages (Elias et al., 1986; Parmelee et al., 1964); and four at three age points (Jacklin et al., 1980; Pinilla & Birch, 1993; Wolfson et al., 1992; Wooding et al., 1990). In Jacklin et al.'s case, data was not collected until the infants were 6-months-old. One study presented data at 5 months (Traisman et al., 1966), and one at 7 and 10 months (Elias et al., 1986).

6.2.2.4. Lack of Direct Measures and Reliability of Measures

The most common measures studies used were sleep diaries or sleep logs. Several authors justified the lack of direct measures by citing the findings of previous studies reporting reliability between parent report and direct observation (Jacklin et al., 1980; Pinilla & Birch, 1993).

Elias et al. (1986) reported reliability between parent report and interview data. No other study did this. They found moderate correlations with the variables of nursing frequencies and nursing duration, and significant consistency for "sharing a bed".

6.2.3. Sleeping Through The Night

This variable was first operationalised by Moore and Ucko (1957), who defined sleeping through the night in the following manner:

The question of how to define night was not easy to decide. In the end we confined our attention to cases where the baby woke and cried or fussed between midnight and 5 a.m. at least once a week....The age at which the child first 'settles' (starts regularly sleeping through the night as defined above)....the age (as estimated to the nearest week from the mother's reports) at which the child began its first period of four weeks or more of sleeping through the night waking less than once a week.
(p. 334)

This period from midnight to 5:00 a.m. has been described as the "conventionally defined hours" for sleeping through the night (Anders et al., 1983) and has remained influential in determining if an infant is sleeping through the night or not (e.g., Anders, 1979; Anders et al., 1983; Pinilla & Birch, 1993). Researchers have used various other definitions to determine rates for sleeping through the night (Armstrong et al., 1994; Michelsson et al., 1990; Wailoo, Peterson & Whitaker, 1990; Wolfson et al. 1992). The results of studies which have considered infants to be sleeping through the night are presented in Table 3.

6.2.3.1. Development of Sleeping Through the Night

As shown in Table 11 the most rapid increase in the number of infants sleeping through the night occurred from birth to 4 months. The few studies that reported figures, show an increase from birth (range 2% to 16%), to 2 months (range 31% to 55%). By 4 months, between 67% to 82% of infants had met researchers varying criteria.

At 5 and 6 months, Moore and Ucko (1957), and Anders et al. (1983), reported an increase in the rates (range 47% to 84%). From TLVR, Anders et al., reported an increase from 6 to 9 months (59% to 79%), which then decreased at 12 months (79% to 44%), in contrast the rate from maternal report continued to increase (74% to 80%).

The only study to report data at 7, 8 10, and 11 months was Moore and Ucko (1957). They reported a minimal increase from 7 to 10 months (86% to 90%). From 10 to 12 months, no further infants were reported to be sleeping through the night.

6.2.3.2. Methodological Considerations

Many of the methodological drawbacks attributed to the studies describing the LUSP, also apply to studies considering rates in sleeping through the night.

Table 11.
Percent of infants "sleeping through the night" across the first year.

AUTHORS	DESIGN/ N	SOURCE	CRITERIA	MEASURE / DURATION	PERCENT OF INFANTS "SLEEPING THROUGH", BY AGE IN MONTHS											
					1	2	3	4	5	6	7	8	9	10	11	12
Anders (1979)	Cross'l 68	Newspaper Ads	Asleep midnight - 5:00 a.m.	1. TLVR 2. Sleep log 1 night	44											1.78
Anders, Keener, Bowe & Shoaff (1983)	Longit'l 40 ¹ 39 ² 19 ³	Medical Centre	Asleep midnight - 5:00 a.m.	1. TLVR 2. Parent Report 1 night	12 ¹	37 ²			47 ²	59 ²		79 ³	74			44 ³ 80
Armstrong, Quinn & Dadds (1994)	Cross'l 3269	Well Child Checks	Parents not disturbed	Questionnaire			71									
Michélssohn, Rinne & Paajanen (1990)	Cross'l 270	Well Baby Clinics	8 hours between 9:00 p.m.-9:00 a.m.	1. Questionnaire 2. Sleep Log for 24 hours			3-8 ^a						9-12	50		
Moore & Ucko (1957)	Longit'l 104	Existing study	Asleep midnight- 5:00 a.m. for 4 weeks	Interview Diary (n=28)	19 ^b	58	71	81	83	84	86	87	88	90	90	90
Pinilla & Birch (1993) ^c	Short term Longit'l 13 ^d	Newspaper Ads	Asleep midnight- 5:00 a.m. 2 of 3 nights of the week	Diary once a week for 72 hours for 8 weeks	5 wk: 15	31										
Wailoo, Peterson & Whitaker (1990)	Descriptive 87	Not stated	Parents not disturbed for 8 hours	Diary 1 night			25									
Wolfson, Lacks & Futterman (1992)	Short term Longit'l 31 ^d	Child Birth Classes	Asleep 300 min for (1): 5 nights (2): 6 nights	Sleep Diary, 15 min blocks for 3 weeks	6 wk: 1.57	8 wk: 2.31	9 wk: 2.48	1.74								

Note. ^a denotes the ages for which data was aggregated, ^b cumulative percent, ^c denotes estimated off a graph, ^d denotes subjects randomly assigned control group. 1,2,3 indicates the 'n' value at each age (e.g. a 1 indicates that the 'n' at that age was 40).

6.2.3.2.1. Lack of consistent definitions

It is difficult to directly compare the findings of these studies because of variation in the criteria applied for sleeping through the night. At least half of the studies employed Moore and Ucko's (1957) "conventional hours" (Anders, 1979; Anders et al., 1983; Pinilla & Birch, 1993). However, the number of nights varied for an infant to meet this criterion, from a period of 24 hrs (Anders, 1979, Anders et al., 1983), to 2 of 3 nights in a week (Pinilla & Birch, 1993), and 6 of 7 nights for the duration of 4 weeks (Moore & Ucko, 1957).

Two studies employed an 8 hour criterion where its location varied: from any 8 hours between 9:00 p.m. to 9:00 a.m. (Michelsson et al., 1990); or where the parents were not disturbed for 8 hours (Wailoo et al., 1990). Armstrong et al. (1994) employed a more lax criterion "without disturbing parents", thus providing little indication of either the duration of uninterrupted sleep, or under what circumstances parents were not disturbed.

6.2.3.3. Methodological and Conceptual Problems with Moore and Ucko's (1957) Study

As noted above, Moore and Ucko's study has been influential in shaping the method of successive investigations of infant sleep patterns. However, the methodological and conceptual problems in their study raise a number of questions regarding the reliability and validity of the study's findings.

6.2.3.3.1. Methodological problems

6.2.3.3.1.1. Retrospective data

The data on "sleeping through the night" was collected retrospectively from the 3 months preceding the interview. During this interview on the infant's general health, the mothers were required to recall very specific infant sleep behaviours. The accuracy of such recall is questionable given the physical and emotional demands on parents in the very early neo-natal period.

One effect of retrospective recall is that data may be biased toward what is expected by the child development specialists conducting the interview, as was found by Robbins (1963). Robbins conducted a study examining parents recall of aspects of child development and child-rearing practices at the same time Moore and Ucko (1957) were conducting their study. She found that when parents of 3-year-olds, recalled details of their child's early developmental progress from birth, that their recall of details was quite inaccurate when compared to prospective data collected from birth to 3 years. She found that parents were more permissive in their practices, than in their prospective reports. This was attributed to parents' recall being influenced by

being seen to follow advice of popular child-rearing experts, such as Dr Benjamin Spock. Spock (1957) advocated termination of the 2:00 a.m. feed in very early infancy. This may provide one explanation why Moore and Ucko reported such high rates for sleeping through in the first 3 months (despite that it was cumulative data). That is, the parents did not want to be seen as "acting against" popular expert advice, and so reported no longer feeding their infant at 2:00 a.m. This early feeding time is located almost half way through Moore and Ucko's midnight to 5:00 p.m. night-time, and not providing an early morning feed, would then define the infant as sleeping through the night.

6.2.3.3.1.2. Lack of clarity in derivation of variables

The method by which Moore and Ucko (1957) arrived at their findings is ambiguous. From an interview on the infant's general development, the rates reported for sleeping through the night were derived from the "nearest week" that mothers recalled their infants to sleep through the night, for 4 consecutive weeks. The validity of this data is called further into question through the use of a calculation to "estimate" the number of infants who were sleeping through the night at each successive age. Neither the measures collected, nor the variables derived from these measures, demonstrate a sound normative base upon which confident decisions on the timing for prevention can be made.

6.2.3.3.1.3. Definitions not based on empirical evidence

The definitions Moore and Ucko (1957) employed to specify if an infant was sleeping through the night have both methodological and conceptual implications for future research. They arbitrarily defined the period of night time as between the hours of midnight and 5:00 a.m. This decision was not based on any developmental data despite publications of earlier studies that presented findings on infant sleep (e.g., Kleitman & Engelmann, 1953). Moore and Ucko did not present data to support the validity of their diagnostic criteria. It is unclear why only awakening after midnight was included, or why the duration of each night awakening was not included in the diagnostic criteria (Weissbluth et al., 1984).

Moore and Ucko (1957) claim nearly 50% of infants who had slept through the night, began awakening ("relapsed") in later infancy. Particularly, at the age of 9 months. These claims must be treated with caution given their figures, it is not possible to derive a rate of "around 50%". At 5 months, 75% of the infants were sleeping through the night (maximum rate over the 12 months), this decreased to 62% at 7 months, 56% at 8 months, and 51% at 9 months. At neither 7, 8 nor 9 months is there a decrease equivalent to "around 50%" of the 75% figure reported at 5 months. Rather a figure of 24% better represents the difference in percentage of the infants

who stopped sleeping through the night from 5 to 9 months. These authors emphasis 9 months as being an age when infants will stop sleeping through the night and relapse to night awakening. This is not reflected in their data.

Such claims need to be challenged, as they may result in misleading information regarding normative sleep pattern development in the second half of the first year.

6.2.3.3.2. Conceptual problems

6.2.3.3.2.1. Infants sleep longer than 5 hours

By 2 months of age infants have been shown to be physiologically capable of sleeping longer than 6 hours (Anders et al., 1983). This suggests that the 5 hour criterion is inadequate to reflect infants' behavioural capabilities for uninterrupted sleep.

6.2.3.3.2.2. Infants begin their LSP and LUSP before midnight

Studies have demonstrated the LUSP and the LSP occurs before, or inclusive of midnight to 5:00 a.m. Even at the earliest (3 weeks), infants are shown to have their LSP occurring between 8:00 p.m. and 8:00 a.m. hours (Coons & Guilleminault, 1984), which is outside the period of midnight to 5:00 a.m. Further, de Roquefeuil, Djakovic & Montagner (1993) reported that by 4 months of age, the duration of the sleep span began outside of midnight to 5:00 a.m.

6.2.3.3.2.3. Infants with ISD may be sleeping from midnight to 5:00 a.m.

Given that the lower bound of the defining age for ISD is 6 months, Moore and Ucko's definition of sleeping through the night has some critical implications. Infants who are 6 months or older, and who sleep through from midnight to 5:00 a.m. may in fact be experiencing ISD. Infants may awaken frequently before midnight and disturb their parents by requiring attention for resumption of sleep. Similarly, early morning awakenings, which occur at 5:00 a.m. have been described by Ferber (1987) as being problematic for parents. Clinical experience by the CSP staff agree that the parents of infants with ISD do not consider midnight to 5:00 a.m. as the hours which best reflect sleeping through the night (France & Owens, 2001).

6.2.3.3.2.4. Parents definitions exceed 5 hours

A definition is required that better reflects parental expectations or definitions of sleeping through the night particularly if they are developmentally appropriate. One would expect it to begin earlier in the night and finish later in the morning. That, is, parent's expectations are likely to cover the 8 hour period when most adults are in bed and expect to sleep.

6.3. GENERAL COMMENT

A critique of the literature is that a substantial amount of relevant data had seemingly been collected by studies but was not presented. For example, rather than present data at separate developmental age points, several studies aggregated data to include a number of age groups (Armstrong et al., 1994; Lee, 1992; Michelsson et al., 1990; Scher et al., 1995; Scher, 1991; Werry & Carlisle, 1982). Presenting data separately across successive ages would provide more developmental data, and thus permit more sensitive measures of the developmental changes in the consolidation of infant sleep. In addition, longitudinal studies could have presented data showing the different pathways by which consolidated sleep patterns developed. For example, the study by Scher (1991) presented data only for infants defined as "night wakers", but they failed to present valuable data on the developments of the non-wakers.

6.4. SUMMARY

1. The most rapid developmental progression in the LSP, LUSP, sleeping through the night occurs during the first 4 months.
2. Lack of developmental data precludes establishing the age at which infants first consolidate their sleep-wake patterns and begin to sleep through the night.
3. Moore and Ucko's (1957) criterion for sleeping through the night remains influential in the field. There are a number of conceptual and methodological problems with this study.
4. The accuracy of the developmental data needs to be tested by a conceptually and methodologically sound study.

6.5. CONCLUSION

This chapter has been primarily concerned with a question that has both practical and theoretical implications, that is, when do infants consolidate their sleep and begin to sleep through the night? Establishing the age at which this developmental task characteristically occurs would identify a period of physiological and behavioural "readiness" for the application of preventive strategies. When infants first sleep through the night can only be partly addressed because of the general ambiguity and confusion in this area of research. There was insufficient developmental data to establish a specific developmentally sensitive time for intervention.

A longitudinal study that collects prospective developmental data is required to adequately address these issues. Such a study would allow for the investigation of different, and behaviourally meaningful criteria that would better reflect the

developments of sleeping through the night. This would assist in informing the timing of primary prevention which must occur in conjunction with the developmental process of sleeping through the night. The current study does this.

CHAPTER SEVEN

EXPLANATORY MODELS OF INFANT SLEEP DISTURBANCE

In this section models explaining the development of ISD will be presented and described. Identifying contributing risk factors is only the first step in planning preventive intervention, because they do not necessarily function in isolation (Mrazek & Haggerty, 1994). Models of ISD, on the other hand, provide hypothetical explanations of how these factors interact, and on what levels, to produce different pathways to sleep pattern development. Prevention intervention must be supported by explanatory models with sound conceptual and empirical foundations that can inform the timing and the factors to be altered in intervention (Coie et al., 2000). In light of these suggestions, four theoretical models are described and examined with regard to how they predict strategies for prevention, i.e., how they specify the mechanisms or processes through which the associated factors have effects, and at what developmental points these may occur providing entry points for prevention.

7.1. A GENERIC MODEL

From their review of the literature on factors associated with ISD, Messer and Richards (1993) developed what I term a generic model, to explain how the factors influenced the development of ISD. The model is considered generic as the authors state it is neither biological nor social. The main assumption is that night waking is caused by neither the mother nor the infant, but rather in interaction within the dyad. Two dimensions of influence are identified: congenital characteristics of the infant, and parental care practices.

The congenital characteristics of the infant which predispose him or her to night awakening are presented in a linear fashion. Contributing factors appear during the ante-natal period, beginning with a raised level of foetal activity, followed by a longer labour, foetal stress and a reduced Apgar score. The newborn infant will be hypertonic, with a raised responsiveness to stimulation. The infant will cry excessively, which then develops into continued awakening and crying. The infant then experiences frequent night awakenings, and develops into a difficult-to-settle toddler.

Two infant factors (excessive crying as an infant, and continued waking and crying) are hypothesised to influence maternal psychological factors, (anxiety, well-being, stress, and frustration with the infant). Three maternal factors are shown to influence the child factors namely anxiety, being a "sensitive mother", and lack of

consistency in patterns. In turn, the psychological factors that predispose the mother to experience her infant's sleep as a problem, are influenced by the mother's familial influences (marital relations) and societal influences (social support, child care information and professional attitudes).

The only identified relational link indicating what predisposes a parent to reinforce crying is shown to occur during the period of toddler-hood. A unidirectional link is posited between two maternal factors: maternal modified child-care (this was not defined), and a lack of consistency in patterns; and a difficult to settle toddler.

The authors suggest that there are a number of developmental paths that result in ISD, and factors which work interactively across a number of different levels. However, this is not clearly demonstrated in the model.

7.2. TRANSACTIONAL SYSTEMS MODEL

Sadeh and Anders (1993) proposed a transactional systems model of the development of sleep wake regulation and sleep problems for the diagnosis and treatment of sleep disturbance. They presented a family systems model of child development and described the ongoing dynamic interactions and bi-directional influences in terms of four interactive systems. Each of the systems contributes to sleep-wake regulation and includes a distal extrinsic context, proximal extrinsic parent context, intrinsic infant context, parent-infant mediating context, and infant sleep.

Until ISD is present, a hierarchy of influence is hypothesised which is interactive on all levels. The parent-infant relationship (e.g., attachment systems, separation-individuation) and interactive behaviours (e.g., bedtime interactions, soothing behaviours, limit setting and co-sleeping) mediate sleep-wake regulation. These factors are strongly influenced by the infant intrinsic context (temperament and biomedical factors) in interaction with the proximal extrinsic parental context (personality, psychopathology, fantasies, representations and working models). The distal extrinsic context pertains to the broader context within which the family lives and is considered to be a secondary effect in the regulation of sleep-wake patterns. They include culture (social and cultural norms, expectations and values, communication and media), environment (economic pressures, caretaking arrangements, socio-economic factors), and family (family stress, family time, marital status, and sibling interaction). The effects of sleep disturbance can affect each of these contexts.

7.3. BEHAVIOURAL MODELS

The key assumptions of Blampied and France's (1993) behavioural models of ISD have been described in Chapter Four. Operant behaviour theory was used to describe the underlying causal mechanisms determining the parent and infant behaviours contributing to ISD. The behavioural model was developed to account for the role of factors involved in the learning of sleep self-initiation, of sleeping through the night, and of parent behaviours in relation to infant behaviour. The authors presented a behavioural analysis of sleep that drew on Bootzin's (1977) key assumptions regarding sleep, and employed this analysis to develop a behavioural model of ISD. The model focused on two key aspects associated with the bedtime behaviour chain: antecedent stimulus control, and the contingencies of sleep compatible and sleep incompatible behaviour.

7.4 . DEVELOPMENTAL MODELS

Three co-ordinated models of ISD recently presented by France and Blampied (1999) (see Figure 1) augment their earlier behavioural model by describing the interactions of proximal factors that influence paths of infant sleep within a developmental context. Within this developmental context the authors integrate the key assumptions of the behavioural model, with the literature on sleep-state development, and infant and parental variables. France and Blampied account for the development of ISD in terms of three different processes: (i) the development of sleep self-initiation at around 3 months of age; (ii) the development of primary sleep disturbance by 6 months of age; and (iii) the development of secondary sleep disturbance later in the first or second year.

Model One describes from birth the pathways to the development of sleep self-initiation skills and how the factors of infant temperament and parental behaviours interact to determine the outcome by 3 months of age. The first component of this model involves the low or high constitutional and environmental vulnerabilities of the infant. An infant would be considered vulnerable if born with a particular physiological (poor sleep state organisation) and/or constitutional (difficult temperament) endowment. These vulnerabilities can in turn influence parents' behaviour which provides environmental factors, again increasing the infant's vulnerability. Parents behaviour will also be determined by their own developmental history (experiences of being parented), attitudes, experiences, and beliefs about parenting, as well as other factors such as, personality, psychopathology, malaise/depression, and response to life stress events.

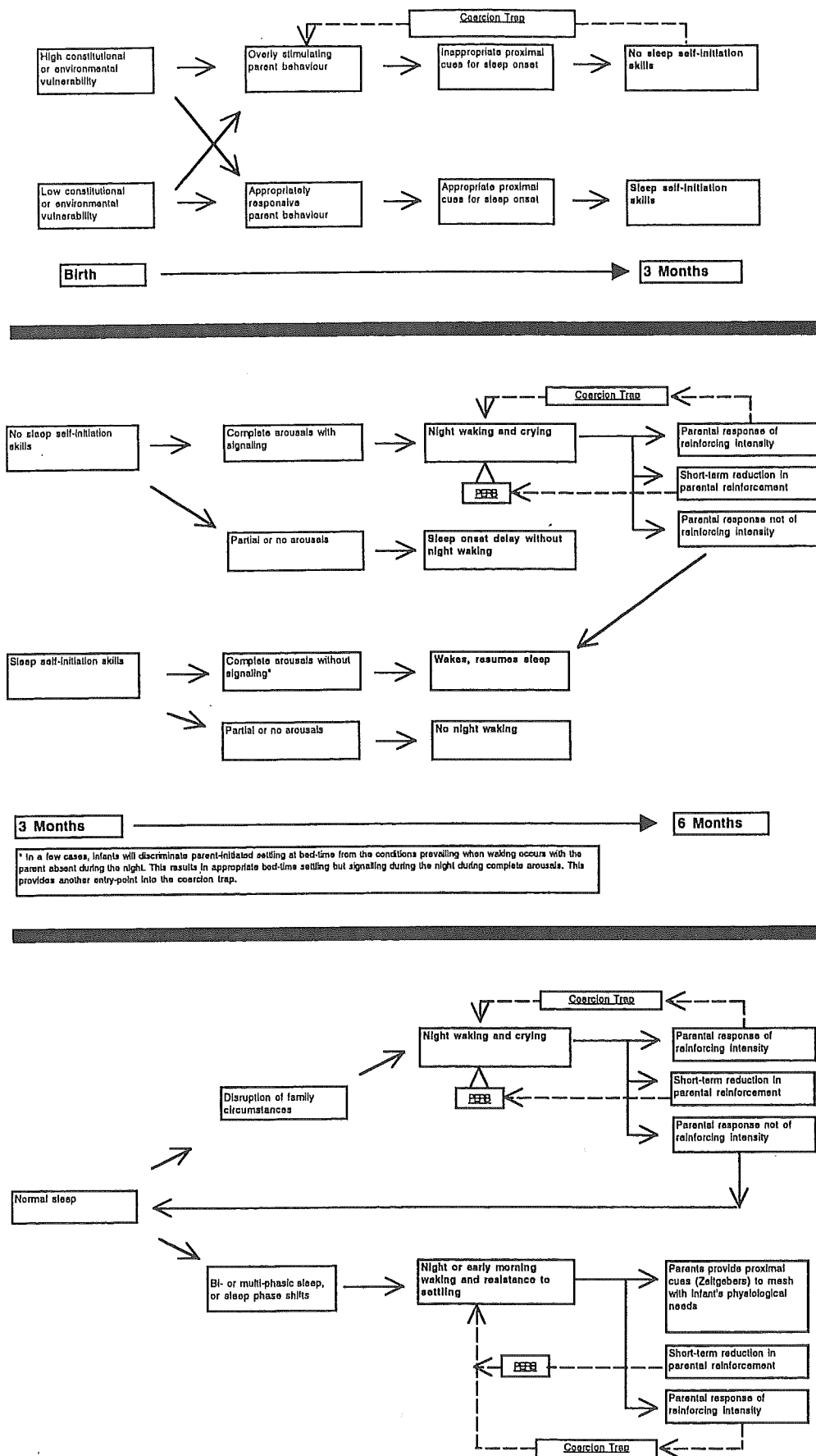


Figure 1. The three-process models of infant sleep disturbance presented by France and Blampied (1999).

These factors can directly contribute to the parental response to the infants temperamental and behavioural characteristics. For example, an infant with certain vulnerabilities (e.g., persistent crying) whose parents are concerned and/or unconfident about their own parenting abilities may handle the infants in an overly stimulating manner, whereas a more confident parent, or one with good support may avoid this over-stimulating response pattern.

The second component of the model is the parents' style of interaction with the infant. Parental practices, or styles of interaction are influenced by the strengths and vulnerabilities the dyad brings into the system. The parent's style of interaction with the infant will be either overly stimulating (where ISD develops) or appropriately responsive. Over-stimulating parental responses that block the establishment of the infants self-soothing behaviours include putting the infant to bed asleep, being present when the infant falls asleep and co-sleeping.

There is an interaction (or crossing of the dimensions) of the parent and infant factors that can result in four outcomes. A high constitutional or environmental vulnerability may interact with either over-stimulating parent behaviour, or appropriately responsive parent behaviour. Conversely, a low constitutional or environmental vulnerability could result in either over-stimulating parent behaviour, or appropriately responsive parent behaviour. Families most at risk are those where the infant and parent factors are both adverse. While the vulnerabilities arise independently, they are additive. Early experience of regulatory disturbances, (e.g., colic or excessive crying), or organic conditions (ear infections or allergies) are potentiating factors for the development of ISD due to the "contingencies such disorders set up for the permanent development of more stimulating parenting" (France & Blampied, 1999, p.273).

The model then draws on the behavioural models' assumptions regarding the establishment of appropriate or inappropriate stimuli for sleep-onset described in Chapter Four. In brief, parents who engage in appropriately responsive behaviour and provide appropriate proximal cues provide the opportunity for their infants to learn sleep self-initiation skills. In contrast, parents who engage in overly stimulating behaviour will provide inappropriate proximal cues for sleep-onset and prevent their infant from developing sleep self-initiation skills. If parents continue to engage in inappropriate proximal behavioural cues such as rocking or feeding the infant until sleep-onset, a behaviour trap is created, in which the parents avoid the aversive situation of the infants crying, and the infant avoids being left to fall asleep alone.

The second model describes the development of primary sleep disturbance which may occur between the ages of 3 and 6 months. It is dependent on the consequences of REM-associated partial or complete arousals. As the infant's sleep becomes progressively more organised with predictable sleep cycles, the relative

maturity of these cycles will determine whether an infant will have a partial arousal and an unbroken sleep pattern, or complete arousals and frequent wakings. Following a complete arousal, an infant who is unable to self-initiate sleep will signal and require parent-supplied discriminative stimuli for sleep-onset, which creates another entry point for the behaviour trap. On the other hand, infants who do not experience complete arousals or have sleep self-initiation skills may develop sleep-onset delay.

The third model describes the development of secondary sleep disturbance in infants over the age of 6 months who have previously demonstrated a pattern of settled sleep. Following a disruptive event (e.g., illness, birth of a sibling, family holiday, change of house) the infant may awaken and cry at night, and if the parental response is sufficiently reinforcing the dyad may enter the behaviour trap. These events may coincide with the developmental period of separation anxiety, which may serve as a potentiating factor that will increase the reinforcing power of parental attention. However, if the parental attention response is not of reinforcing intensity it decreases the likelihood of the development of secondary ISD.

Infants may develop sleep-schedule problems such as bi- or multi-phasic sleep, or sleep phase shifts as a result of unreasonable parental expectations of sleep duration at different ages. An infant who has sufficient sleep will require parents to alter the sleep times and employ the use of environmental Zeitgebers (e.g., light-dark cycle, temperature) as cues for sleep-onset.

7.5. IMPLICATIONS FOR PREVENTION

All of the models were presented as interactive and transactional, thus acknowledging the multiple levels and pathways of influence that contribute to the development of ISD. It is interesting given the different theoretical orientations of the models that there were common bi-directional and interactive influences hypothesised as resulting in the development of ISD. Parental characteristics and handling practices, and the infant constitutional and physiological endowments assumed prominent positions of influence within each model. Consequently, one of the main assumptions in each model was the parent-infant bed time interaction and the development of ISD.

Messer and Richards' (1993) generic model was a representation of factors associated with ISD. This model has value in how it sets out the factors associated with ISD, but offers little towards understanding the mechanisms, their triggers, and the developmental context within which ISD develops. They described this generic model as relational with problems originating in the relationship of the mother-infant dyad. Yet, the model showed no bi-directional influences between the mother and infant dyad. Rather, the bi-directional influences were shown to be between distal and maternal factors. The infant constitutional factors were presented in a linear fashion

which suggested a set pathway which originates with a raised level of foetal activity. No mediating factors were presented to suggest a possible exit from this pathway to ISD. Maternal handling was not a potentiating influence until toddler-hood. Management studies, however, have clearly demonstrated the role of maternal handling in the maintenance of ISD in infants as young as 6 months (e.g., Johnson & Lerner, 1985; Lawton et al., 1991; Rickert & Johnson, 1988). There is an overall deficit in the model in regards to the risk and protective factors associated with parental behaviour and ISD. Further, the proximal factors of "modified child care patterns", "lack in consistency in patterns", and "waking and crying" in the model were not operationalised nor sufficiently explicated. Because of these problems this model does not lend itself to testing for preventive purposes, because it does not suggest triggers that activate the underlying mechanisms, entry points for intervention, or how to intervene.

A strength of the transactional systems model (Sadeh & Anders, 1993) lies in its acknowledgement of the influences of both distal and proximal factors on the development of infant sleep patterns. They are presented from a family systems perspective through an account of how normal and abnormal sleep develops through ongoing transactions between culture, environment, family, parents, and infants. From these transactions there are multiple outcomes of sleep disturbances of which the authors provided a number of vignettes. These authors delineated the maturation of sleep-states separately from the regulation and consolidation of sleep and wakefulness. This was a comprehensive and theoretically sophisticated model.

In terms of an explanatory model of the development of infant sleep the psychodynamic model does not readily lend itself to testing. Mainly because the model was developed to account for the dynamic interactions and influences for the purpose of assessment and intervention of ISD. There was no specific developmental framework suggesting entry points at which sleep problems can develop in relation to the developmental task of sleeping through the night. The multiplicity of influences are not described in sufficient detail to enable the testing of the mechanisms, or the processes, that influence the pathways of sleep development. Rather the intention was to provide a description of the interactions, the mechanisms, and the triggers that activate these mechanisms for use in the assessment of existing sleep problems and to guide the management interventions.

France and Blampied's (1999) three explanatory models provided the most comprehensive and theoretically sound hypothesis of the developmental pathways of infant sleep patterns. It was the only model which presented a developmental framework within which different entry points were suggested for the development of disturbed sleep patterns during infancy. The behavioural model's assumptions were incorporated to explain the role of learning in sleep self-initiation and sleeping through

the night and the coercive behaviours. Each variable in the model was operationally defined and therefore testable.

In regard to hierarchy of influence on the development of ISD, the learning of sleep self-initiation skills at an early age assumes a prominent position. A deficit in this behaviour has a cumulative effect that may result in primary ISD by 6 months of age. Infants who have not learned sleep self-initiation skills in the first 3 months, may not resume sleep following a complete arousal without parent-supplied discriminative stimuli. Depending on the intensity of parental response, they may develop a night awakening problem. Those infants who do not experience complete arousals may develop sleep-onset delay.

Preventive intervention should therefore occur in the early neonatal period to prevent the cumulative effects of lack of sleep-self-initiation skills. While there are a combination of risk factors which predispose the infant to develop ISD, a number are malleable to intervention, and from the outset should be considered in the first instance for prevention. Because of developmental changes and the cumulative effects of a deficit in the skill of sleep self-initiation the timing may be critical. The reduction of the risk factors of over-stimulating parental behaviours should be targeted in the first instance so that protective factors can be increased and sleep-onset delay and problematic night waking may be avoided.

France and Blampied's (1999) model provides a framework for understanding the specific mechanisms (and their interactions) in the normative development of infant sleep, and conversely how ISD may develop. This model therefore allows the formulation of research questions (France and Blampied, 1999), and readily lends itself to be tested by a longitudinal normative study.

Two of the developmental model's key assumptions need to be tested before basing preventive intervention on the models. First, the age based developmental trajectory is based on the findings of Moore and Ucko's (1957) early study. The conceptual and methodological problems of this study have been described in detail in Chapter Five. Further research is required to validate Moore and Ucko's findings on the progression in the development of infant sleep patterns. Second, the parental behaviours described as providing inappropriate discriminative control over sleep self-initiation have not yet been demonstrated to antedate and predict ISD.

7.6. SUMMARY AND CONCLUSION

The last decade has seen progression in the study of infant sleep. This has ranged from the identification of a wide range of factors associated with sleep disturbance, to establishing more specific distal and proximal factors associated with ISD. Such findings have allowed for the development of explanatory theoretical

models of ISD. This chapter reviewed explanatory models with the aim of establishing which would offer the best guide for conducting preventive intervention for ISD.

Despite a substantial body of research literature on factors associated with ISD there are only four explanatory models (one other explanatory model was presented by Wolke, 1995c, but has no English translation). Despite the different theoretical approaches of France and Blampied's (1992) and Sadeh and Anders (1993) models, both are dynamic, bi-directional, and point to direct and indirect links between the various factors that influence the development of ISD. Data was also provided to support the bi-directional interactions of the proximal factors between the parent-infant dyad which assumed a prominent position in the development of ISD. Neither model has been tested empirically, a step necessary to determine their applicability to conducting preventive intervention. What differentiates France and Blampied's model from Sadeh and Ander's for guiding preventive intervention models is the developmental framework for testing specific assumptions of the underlying causal mechanisms of ISD.

Further research is required to complete gaps in empirical knowledge before basing preventive intervention on France and Blampied (1999) models. A normative study clearly needs to be conducted to test the assumptions regarding the contributing parental behaviours and the progressions in sleep pattern development.

CHAPTER EIGHT

RATIONALE AND AIMS

In the previous literature review the research on infant sleep was reviewed according to relevant criteria suggested by Mzarek and Haggerty (1994) for evaluating preventive interventions. It is imperative that the decisions made for planning effective intervention for ISD are empirically based and theoretically sound. The review indicates that a number of the requirements specified by Mzarek and Haggerty have been met, while others have not. Further research is therefore required to fill the gaps in our knowledge base, in order for preventive intervention to be properly conducted.

In Chapter One, one of the first steps in the preventive intervention research cycle was described. Infant sleep disturbance was identified and defined both operationally and reliably, and the target population for the prevention of ISD identified and described. Chapter Two presented evidence to demonstrate that infants are in fact at risk of developing ISD. The review demonstrated that between 19% and 46% of infants experience sleep disturbance at varying ages over the first year of life. Additionally, evidence was provided of the continuity or persistence of ISD. Chapter Three then addressed one of the criteria crucial for preventive intervention, that is the identification of risk factors associated with ISD. In order for a risk factor, to be valid it must be shown to precede and to be predictive (Coie et al., 2000), in this case of the emergence of ISD. While there are a myriad of well-documented risk factors associated with ISD none thus far have emerged as essential to the design of preventive intervention, i.e., none have been demonstrated to either precede or be predictive of ISD.

Chapters Four and Five, respectively, considered relevant research on the management of ISD, and prior preventive intervention research. Principles of operant behaviour theory were used to clarify the underlying mechanisms of parental behaviours contributing to the maintenance, if not to the cause of ISD. On the basis of this theoretical framework, it was predicted that preventive studies would consider these contributing factors in their intervention programmes. This proved partially true. Preventive interventions described in Chapter Five demonstrated some short term positive effects. The true efficacy of these programmes, however has potentially been masked due to methodological and conceptual problems. Preventive interventions must be based on developmental tasks, in this case sleeping through the night, and also on risk factors shown to be associated with the developmental task.

The timing of preventive interventions varied, reflecting different assumptions as to when infants first begin to sleep through night and thus when it is developmentally optimal to intervene. Similarly, decisions on how to intervene for preventive purpose are unclear. The variation in techniques parents were trained in reflects that the decisions authors made about what to change were not, as suggested by Coie et al. (2000), based on empirically validated developmental theory.

In Chapter Six the empirical literature on the development of infants' sleep was reviewed with the aim of establishing when infants first begin sleeping through the night, and when majority of infants meet this developmental task. Although this occurs at some point in the first four months, exactly when infants are most likely to achieve this developmental task is less clear. The wide diversity in the methods used to investigate the phenomenon makes it difficult to establish at what age the highest likelihood of sleeping through occurs, and therefore, by what age the majority of infants will be sleeping through.

With these gaps in the knowledge base for preventive intervention in mind, Chapter Seven reviewed explanatory models in an attempt to identify one which best provides a theoretical model to guide preventive intervention. Selection of the model would involve one that specified the target group most at risk, the timing of the intervention, and also identification of the factors to be altered by the intervention (Coie et al., 2000). A three part developmental model (France & Blampied, 1999) proved the most amenable to direct testing as it presents both a developmental and operant framework with a number of entry points to account for the development of ISD. Each of the entry points identifies parental behaviours that are both malleable to intervention and accounted for in a description of the relationship between the risk factor/s and the developmental task. However, the predictions of this model regarding the roles of parent and infant behaviour in the development of ISD have yet to be tested by a prospective longitudinal study.

Clearly then, a normative study is required to test assumptions about a consistent developmental progression in sleep pattern development, as well as the causal status of parent behaviours suggested in the developmental models (France & Blampied, 1999). This claim is further supported by the analysis of the literature which demonstrates that more empirical evidence is required to plan for an effective, rigorous preventive intervention. More developmental information is required on the development of infant sleep patterns, and on the identification of factors which precede and are predictive of ISD. Only then can empirical decisions for preventive intervention be employed. On the basis of the gaps in the research an overarching question regarding preventive intervention remains unanswered. That is, how should preventive intervention be conducted? In order to investigate this question several areas of previous research and current theoretical frameworks must be drawn on.

To quantify the investigation, two questions were operationalised: (i) when is the optimal time (developmentally) for preventive intervention; and (ii) how should preventive intervention be conducted? These two questions are addressed separately in a prospective longitudinal study with repeated measures. This study examined the development of infant sleep patterns during the first year of life and the relationship of parent behaviours to these patterns.

Study One and Study Two aimed to complete the research necessary for planning of preventive intervention that is empirically based, by investigating the following two questions:

8.1. WHEN IS THE OPTIMAL TIME FOR PREVENTIVE INTERVENTION?

In order to address this question the following three clusters of research questions were investigated in Study One:

1. Sleeping through the night:

- (i) At what age is sleeping through most likely to occur?
- (ii) Over what period of time do the majority of infants sleep through the night?
- (iii) Which definition of sleeping through the night best represents the developmental task of sleeping through the night ?

2. The Longest Uninterrupted Sleep Period:

- (i) What durations in LUSP are infants behaviourally capable of, at successive ages across in the first 12 months of life?
- (ii) Between what ages is the greatest increment in the duration of LUSP over the first 12 months of life?

3. Sleep Behaviour Scale:

- (i) At what age are there two clearly identifiable groups, as shown by a distribution in the frequency of SBS scores, which indicates a group with sleep-disturbed behaviours and a group without?
- (ii) What score best discriminates these groups at that age, and at 12 months?
- (iii) What, if any, effect does parent-initiated intervention have on SBS scores?

8.2. HOW SHOULD PREVENTIVE INTERVENTION BE CONDUCTED?

To address this question the following clusters of questions were investigated in Study Two:

1. Infant behavioural risk factors:

- (i) At 1 month of age which infant factors described in the developmental model (France & Blampied, 1999), precede ISD at 6 and 12 months of age?
- (ii) At 1 month of age which parent factors described in the developmental model (France & Blampied, 1999), predict ISD at 6 and 12 months of age?

2. Parent behavioural risk factors:

- (i) At 1 month of age which parent factors described in the developmental model (France & Blampied, 1999), precede ISD at 6 and 12 months of age?
- (ii) At 1 month of age which parent factors described in the developmental model (France & Blampied, 1999), predict ISD at 6 and 12 months of age?

According to Mrazek and Haggerty's (1994) criteria the questions in each cluster have not been resolved by previous research for conducting preventive intervention. The first three clusters will be addressed in Study One with aim of providing sufficient developmental information regarding the developmental task of sleeping through the night. This is necessary to inform the timing for preventive intervention so that intervention occurs before the emergence of ISD and when infants are developmentally "ready". The latter two aims will be addressed in Study Two to identify factors that precede and are predictive of ISD therefore making them candidates for preventive intervention.

PART TWO:

THE STUDIES

CHAPTER NINE

METHOD COMMON TO BOTH STUDIES

9.1. DESIGN

This was a descriptive research study that employed a prospective longitudinal design with repeated measures.

9.2. PARTICIPANTS

The participants of the study were 75 infants and their parents (see below for detailed description). They were recruited via Community Health Nurses who distributed flyers at the first home-visit to parent's with a newborn infant, newspaper advertisements, antenatal classes at one local maternity hospital, and from the neonatal ward at another large maternity hospital (see Appendix A). The initial aim was to recruit the infants at one month of age, however, the sample ended up consisting of 52 infants whose parents returned a diary in their first month, and 23 whose parents completed and returned the first diary for the infants in their second month.

Parents volunteered for the study between May 1995 and November 1997. Originally 104 participants volunteered, from these 23 withdrew for the following reasons (numbers in parentheses): no reason and no diary returned (4); shifted from area (2); maternal/family illness (3); infant illness (5); maternal depression (self-report) (3); infant's sleep pattern too disruptive (4); child abuse (1); mother too busy to complete diary (1). The majority of these families withdrew within the first month of volunteering for the study. Only one family (child abuse) withdrew after completing more than three diaries. Data from a further six families was removed because they did not return diaries for a minimum of seven different age points (months) of a possible 11 or 12 (months), over the duration of the study. Not one of these families returned the key diaries when the infants were 6 and 12 months of age. This left 75 families who provided a data set with mean return rate of 10.2 (range 7 -12) months of diaries out of a possible 12.

For follow-up, of the original sample of 75 participants, a total of 53 (70%) were located 12 months (or just after), the completion of the study. Of the original sample, 22 (30%) were unable to be located.

Table 12.
Sociodemographic characteristics of the participants.

		Responders		Non- Responders	N.Z Norms	
		n=75	%	n=21 ^a	%	%
Child's Sex	Male	42	56	10	47.6	
Birth Order	1	25	33.3	9	42.3	
	2	43	57	5	23.8	
	3+	7	9.3	5	23.8	
Socioeconomic Status ^b						
	1 - 2	28	37	7	33.3	18.5 ^c
	3 - 4	43	57	11	52.3	56.0
	5 - 6	4	5	3	14.3	25.5
Marital Status						
	Single	1	1	2	9.5	
	Two Parent	74	99	19	90.5	
Educational Attainment of parents						
<i>Mothers</i>						
	University Degree	25	30.7	3	14	8.5 ^d
	Other Tertiary Qualification	15	20	1	5	25.4
	Higher School Qualification	21	28	2	10	5
	Sixth Form/School Certificate	17	22.7	10	48	20.7
	No Qualification	0	0	5	24	33.9
<i>Fathers</i>						
	Higher Degree	26	26.9	4	21	8.5
	Other Tertiary Qualification	11	14.9	2	11	25.4
	Higher School Qualification	10	13.5	1	5	5
	Sixth Form/School Certificate	18	23.9	8	42	20.7
	No Qualification	10	13.5	4	21	33.9
Age and Ethnicity						
<i>Mother</i>	Mean Age y (sd)	30.0 (3.4)		29.0 (5.06)		
	Maori	4	5	0	0	7 ^d
	Pakeha	71	95	21.0	100	
<i>Father</i>	Mean Age y (sd)	32.6 (4.7)		32.0 (5.40)		
	Maori	3	4	0	0	7
	Pakeha	71	96	19	100	
Children per Family (M)		1.6		1.8		

Note. ^a Data was missing for two of the non-responders (n=23),

^b Family socioeconomic status as rated on the Elley-Irving Scale (Irving, 1991), where 1 = high and 6 = low.

^c Percentage of male labour force (25-44 age group) in each socioeconomic level (Elley & Irving, 1985).

^d N.Z census (Statistics New Zealand, 1996).

9.2.1 Characteristics of the Participants

Infants were included in the study if they were healthy and developing normally according to their parents. Infants with suspected developmental delay or medical problems were excluded. No infant was excluded at the beginning of the study for these reasons. The participants comprised 35 (43.2%) females and 46 males (56.8%). Of these, 33% were first born, 57% were second born, and 8% were third born. Only one child was the fifth born. Hence, 99% of the family composition was accounted for by families with no more than three children (Table 12).

Basic demographic information such as ethnicity, parents age, socio-demographic status as assessed using the Elley and Irving scale for the New Zealand population (Irving, 1991), and family composition data is given in Table (12). Compared with population norms (Elley & Irving, 1985), the sample is more representative of families of high socio-economic status, than of families with low economic status, but is representative of families of middle socio-economic status. In general, the parents were well educated and exceeded the population norms for educational levels reported in the New Zealand 1996 census. The only difference in ethnicity was that 5% percent of mothers and 4% of fathers identified themselves as Maori, and the remaining parents identified themselves as Caucasian New Zealanders. This was also comparable with the 1996 Census for the Canterbury region. No families identified themselves as belonging to other ethnic groups.

9.2.2. Characteristics of Non-Responders

Sociodemographic data was not collected from two of the 23 non-responders. As shown in Table 12 the non-responders and participants were comparable on most socio-economic variables. Mothers and fathers in the non-responders group had a lower average education attainment than the responders. No parent was identified as Maori in the non-responders group. Three (14%) of the non-responding mothers self-reported experiencing depression, and were not willing to complete the diaries. Four (17%) of the non-responders considered their infant's sleep too disruptive to be able to complete a sleep diary. Whether in fact these infants had more disturbed sleep patterns compared with infants in the study cannot be established.

9.2.3. Recruitment Procedures

Recruitment procedures were formulated in accordance with the guidelines from the University of Canterbury Human Ethics Committee and the New Zealand Plunket Society. All procedures were approved by the University of Canterbury Human Ethics Committee (see Appendix B) and the New Zealand Plunket Society.

Information leaflets were provided to recruitment sources. These stated that the research was investigating the development of infants' sleep, and parents would be

required to complete sleep diaries. Parents were invited to contact the Canterbury Sleep Programme researcher by telephone if they were interested in participating, and/or for further information regarding the study (see Appendix A).

During the first telephone contact the researcher explained the purpose and requirements of the study. The parents were told the research involved answering a few basic socio-demographic details, and that a sleep diary needed to be completed for six consecutive days, once a month, each month during the infant's first year. Parents were also told about the option of TLVR. The parents were informed that all contact was to be via telephone only, unless they were willing to have a TLVR in their homes. They were guaranteed anonymity by being assigned a research code number known only to the researchers. The parents were also informed that they could withdraw at any time from the study.

During the initial call, the infant's eligibility was established. That is, that the infant was full term, healthy and that the parents had no developmental concerns. The majority of parents gave verbal consent at this point. Eligible parents who indicated an interest in participating in the study were then sent an information sheet, consent form, (see Appendix C) and sleep diary for the first month (see Appendix F). Verbal consent was obtained to conduct a follow up phone call a week later.

During the second phone call, the parents who consented to participate provided socio-demographic information to the researcher. The researcher explained how to complete the diaries using the infant's sleep pattern the previous night as a model. Parents were then instructed to begin completing the sleep diaries for the next six consecutive days and nights. For each successive month the parents were asked to begin completing the diaries on the same date of the month as they began the first diary. They were instructed not to complete the diaries if the infant was ill, or became ill during that week, but to delay until the child was well. Parents were thanked for their participation and informed they would be rung once the diaries were sent in.

When a parent returned a set of diaries, a researcher called, expressed appreciation and obtained clarification on any incomplete responses, or answered any queries the parent had. The parents were also asked if their infant's sleep pattern had been typical for the week and any possible reasons why not. Subsequent diaries and stamped self-addressed envelopes were then posted to the parents. Parents who indicated an interest were sent an information sheet describing the TLVR and the associated consent form (see Appendix C).

If diaries had not been returned within two months parents were telephoned. If parents decided to withdraw from the research, they were thanked for their participation, and offered a copy of the results of the research when available.

Eight months after the study began a "thank-you" letter (see Appendix D) was sent to all of the participants. In this letter the parents were again invited to have the

TLVR in their homes. The majority of parents who had the TLVR in their homes were given a complimentary dubbed video of their infants.

When the infants had reached 12 months of age a further "thank-you" letter was sent (See Appendix D).

Follow-up:

When the infants were 24 months of age the parents were contacted via telephone to collect follow-up data specifically for the SBS (see Study One) using a Sleep Questionnaire (see Appendix E).

Parents were also given an approximate date for a report on the findings of the research.

9.3. MEASURES

9.3.1. Sleep Diaries

The main measurement instrument was a Sleep Diary that was adapted from France's (1989) original study and used routinely by the CSP in management intervention studies. It was modified to include more information on parent and infant variables. It is an A4 sheet laid out in a grid that enables six days and nights of recording beginning with the first sleep of the day and finishing at "time up" the following morning (see Appendix F). Each day's record was separated into "day sleep" and "night sleep". The "day sleep" section allowed the recordings of time, location and duration of day sleeps to a maximum of three sleep periods. The "night sleep" section noted the actual bedtime routine leading to sleep-onset, whether parents were present for sleep-onset, if the infant was placed into the cot asleep or awake, as well as the actual time of the initial night sleep, and parent responses if the infant cried or called out. In addition, the time, duration, and parental behaviour, for a maximum of seven awakenings during the night were noted, as were the final "time up". Parents directly wrote in the sleep-related behaviours both they and the infant engaged in. On the reverse were instructions for completion of the diary and definitions of parent and infant behaviours. There was also a 24 hour example of a completed diary (see Appendix F).

9.3.1.1. Infant and Parent Measures

In summary, the diaries allowed for the following infant sleep and parent behaviours to be measured:

1. The time, duration and location of day sleeps.
2. The routines parents engaged in to get the infant ready for bed.
3. The actual time the infant was first placed into the cot.
4. The state the infant was in when placed into the cot (i.e., awake or asleep).
5. The time from placement in bed until the infant was silent, and the type of the noise the infant made during this time, for example, calling out, crying or talking.
6. Whether a parent was present or absent during infant sleep-onset.
7. The time and duration of each night awakening.
8. Parental responses to each night awakening.
9. Time awake the following morning.

Parents were asked to record this information as it occurred, or first thing in the morning.

9.3.2.1. Definitions of Variables Employed

1. Parent rituals:

These were any responses to the question "how did you get baby ready for bed?".

2. Time down:

This was the time the infant was placed into the cot at the beginning of the night.

3. Parental presence at sleep-onset:

This was rated if parents stated they were present with the infant when he or she fell asleep.

4. Infant state when placed in the cot:

"Asleep" was when parents stated they placed the infant into the cot asleep at the beginning of the night.

"Awake" was when parents stated they placed the infant into the cot awake at the beginning of the night.

5. Frequency of night awakening:

Night awakenings were any awakening recorded on the diary which was sustained for more than two minutes. This minimum period allows for sleep

related signalling (e.g. during REM) to occur. Night awakenings occurred between the time down (first substantial period of quiet at night) and the time awake in the morning. The "morning awakening" was the usual CSP criterion of after 6:00 a.m. Any awakening before this time was considered to have occurred during the night.

6. Duration of night awakening:

This was the length of time the child was awake after each awakening. It included the length of time he/she was attended to by the parents and the length of time he/she was signalling.

7. Parent interventions following a night awakening:

A parental intervention was any interaction with the infant during a night awakening.

8. Total Sleep Time (TST):

This was the sum duration in minutes of sleep episodes for each day and night of the diary.

9. Longest Uninterrupted Sleep Period (LUSP):

The LUSP was the total duration in minutes of the longest period of sleep uninterrupted by signalling for each day and night of the diary.

10. Sleep/Wake transitions:

A sleep/wake transition was recorded when an infant had a paired "sleep-then-wake" episode over the day and night.

11. Sleep Behaviour Scale (SBS):

The infants' sleep patterns were summarised each month using scores on the Sleep Behaviour Scale (Richman, 1981, 1985). The composite sleep score (a summary variable that provides an overall measure of the sleep pattern) was computed from each set of infant diaries.

The scale provides a standard method of summarising a wide range of observations, so it accommodates variability in the topography of infant sleep disturbance (France, 1989). Sleep-relevant behaviours assessed by the scale included: (i) sleep-onset delay (defined already); (ii) number of nights per week in which night awakening was observed; (iii) mean number of awakenings each night; (iv) average time awake per awakening; (v) mean total hours spent sleeping per day; and, (vi) total

hours spent in the parents' bed per week. Scores on individual items were computed by averaging each set of six days data (or in some cases less than six days) and summed to give a score of 0-24 (See Appendix G). Higher scores indicate more sleep disturbance.

Published data on the internal consistency of the SBS has been presented by Minde et al. (1993). They assessed the interrelations of the scales' six parameters using a clinical group of infants with ISD, and a control group. They found that item scale intercorrelations were generally low. This is not surprising, as one would expect intercorrelations to be low given the varied topography of ISD. The intercorrelations ranged from .06 (bedtime vs. time of waking up in the morning) to .44 (time child woke up in the morning vs. number of wakings at night). Two items, (number vs. length of wakings per night), were however, highly correlated (.84). A Cronbach's alpha of .77 was obtained for the overall internal consistency. This makes it an acceptable result for internal consistency, providing support for the validity of the measure.

Studies have used various cut-off points on the SBS to determine ISD. According to Richman (1985) a score between 8 and 11.9 is considered to reflect a "moderate" sleep disturbance while a score of 12 indicates a "severe" sleep disorder. The following cut-off scores have been employed by studies to differentiate between a settled and a clinically disturbed sleep pattern: greater than 2.7 for infants with a mean age of twenty months (Richman, 1984), greater than 4 for infants aged between 8 and 20 months (France, 1989), 12.0 and 12.6 for "poor" sleepers and 4.9 and 2.3 for "good" sleepers aged between 12 and 36 months (Minde et al., 1993).

The SBS was employed in the current study for two purposes. Primarily it was used diagnostically to determine disturbed sleep patterns from 6 months of age. Secondly, it was used for normative purposes, to provide information on the frequency of SBS scores at each age over the first 12 months, and at 24 month follow-up.

There are problems with using the SBS with very young infants, primarily because it has not been previously used with infants of this age, nor has it been used for normative purposes. It would be anticipated that young infants would achieve high SBS scores. Up until 6 months of age, typically an infant will receive at least one night feeding. This would result in score of 6 or above. In addition, if an infant sleeps less than 12 hours in total at night this would also increase the score. This outcome is highly likely given Anders et al. (1992) found that the total sleep time for 3- week and 3-month-old infants was respectively 7.2 and 7.9 hours. The SBS was employed in this study with these considerations in mind, in order to provide a measure which could be used over the whole 12 months. Owing to these developmental

considerations, the absolute scores were not used diagnostically in the study for infants less than 6 months old.

9.4. RELIABILITY

9.4.1. Reliability Assessment

Reliability scores were derived from the sleep diaries and all-night-infra-red time-lapse video recordings over two consecutive nights. The TLVR used for the filming was first described and employed by Anders (1979). This is a non-invasive method of determining reliability that employs an invisible light source in order to allow filming under conditions of little or no illumination. The time-lapse video allows 12 hours of recording to be stored on 1.5 hours of tape. The video was placed on a tripod, with a monitor below and was trained on the infant's cot. The parents activated the system when they placed the infant into bed, and then deactivated it when they removed the infant from bed the following morning. The equipment was delivered and set up by the researcher.

9.4.1.1. Time-Lapse Video Recording

Thirty-three parents of infants in the study volunteered to have the TLVR in their homes to record their infant's sleep. Employing the objective measure of TLVR is a financially expensive task and this is why reliability data could not be collected for more than 41% of the sample. Of these 33 participants, seven provided reliability data for each month for 12 consecutive months, the remaining 26 participants had the TLVR in their homes for two consecutive nights.

Reliability was obtained for: (i) the time the parents placed the infant in the cot at the beginning of the night; (ii) infant state when placed into the cot at sleep-onset; (iii) the frequency of night awakenings; and, (iv) time up in the morning. These behaviours were chosen because they are specific to the measures in Studies One and Two, they are discrete events and are easily coded off the video and diaries. Parental presence at sleep-onset, parental behaviours engaged in during sleep-onset, and also following night awakenings could not be measured for reliability because they often occurred away from the view of the camera. Coding reliability of LUSP durations is a very time consuming exercise, and training inter-observers as coders to differentiate between different sleep states was beyond the financial resources of the thesis. Reliability of total sleep time and sleep/wake transitions could not be obtained as some behaviours occurred during the day, and could not be recorded by TLVR.

Using a point by point agreement ratio (Kazdin, 1982) levels of inter-observer agreement were calculated separately for each variable. The TLVR and parent records

were scored independently by two researchers. Each separate night on the video tape was coded for each of the four variables described above. This data was then compared with the parent report sleep diary by a third independent observer. Positive agreement for each behaviour was defined as both recording systems (parent diary, video tapes) noting its occurrence within a 10 minute period. On each occasion that the records did match, a "hit" was scored, and if they did not match they were scored as a "miss". This was then converted into separate percentage scores for each behaviour.

Results of reliability assessment for this study are presented in Table 13.

Table 13.

Reliability of time down, infant state, frequency of night awakenings, and time up.
Parent records against time-lapse video records.

Parents records vs. Time-Lapse Video Records				
	Time Down	Infant State	Frequency of awakenings	Time up
% Agreement	97	98	93	97
Range	(93 - 100)	(50 - 100)	(50 - 100)	(93 - 100)

There was a high level of agreement between the TLVR and parent records for all four variables. This is consistent with other studies (Blampied & France, 2001; Minde et al., 1993). Those ranges with a lower bound of 50% for infant state and night awakenings can be explained by the TLVR being in a number of homes for only two nights. If there was a "miss" coded for one behaviour recorded on one night, and a "hit" for one instance of the same behaviour on the alternate night, then there can only be a 50% or 100% agreement for the recording period of that participant. The high percent agreements for the variables of infant state and frequency of awakenings indicate an extremely low occurrence of misses. These results were well above the 80% criterion expected by usual convention (Cooper et al., 1987).

CHAPTER TEN

STUDY ONE: TIMING PREVENTIVE INTERVENTIONS

10.1. INTRODUCTION

The timing of prevention for ISD needs to be based on the empirically derived developmental task of sleeping through the night. This is necessary so preventive interventions can occur in synchrony with this process. In the case of ISD we need developmental data on infant sleep, specifically the developmental task of sleeping through the night, to inform the timing for preventive efforts. Sleeping through the night occurs when an infant's sleep shifts from multi-phasic sleep over the 24 hour period, to a monophasic event of consolidated sleep in the night (Sadeh, Raviv & Gruber, 2000). It is a complex phenomenon, because "sleeping through" does not necessarily mean sleeping without awakening (Anders, 1979). It is best operationalised as the LUSP which includes both sleep and quiet wakefulness accompanying arousals. Infants typically awaken one or more times during the night, and some will resume sleep without disturbing their parents thereby contributing to the LUSP. Others will signal and require parental attention in order to resume sleep (Anders, 1979; Anders et al., 1983; Anders & Keener, 1985; Anders et al., 1992; Minde et al., 1993). These infants have a short LUSP indicating their inability to sleep through the night. Empirical studies investigating the developments in the consolidation of infant sleep have measured it in variety of ways, using both the LSP, and also the LUSP, which have been described in detail in Chapter Six. Here the use of the LUSP is advocated as representing the most behaviourally meaningful measure of sleeping through the night.

Establishing the age at which infants first begin to sleep through the night is critical for the timing of preventive intervention. The age when this task is most likely to occur provides a physiological and behavioural marker that indicates a "readiness" for preventive intervention. Prior to this period of developmental transition, a window for prevention may be available that allows for intervention to occur in synchrony with the normative developmental process of sleeping through the night. Alternatively, preventive efforts may be targeted when the infants begin to lag in this developmental progression, but before sleep-disturbed behaviours have begun to emerge and stabilise.

The efficacy of prevention intervention depends in part, on its adherence to temporal issues in development (Cicchetti & Cohen, 1995). The five previous

preventive studies made assumptions about sleep development. These have varied, and have been described in detail in Chapter Five. In brief, three of the studies instructed parents to begin intervention following the birth of the infant (Goodlin-Jones et al., 1997; Pinilla & Birch, 1993; Wolfson et al., 1992). In contrast, two other studies began preventive intervention when the infants were 3 (Kerr et al., 1996) and 4 months of age (Adair et al., 1992). On the whole, the preventive studies did not present decisions for the timing of preventive intervention that were based on empirically derived developmental theory. This is reflected in the assumptions about when it is worth parents acting to facilitate sleeping through the night. The efficacy of prevention intervention depends in part, on its adherence to temporal issues in development (Cicchetti & Cohen, 1995).

Nearly fifty years ago, Moore and Ucko (1957) published an influential study investigating the development of sleeping through the night. Rather than measuring the LUSP, they arbitrarily defined this behaviour as the infant consistently sleeping uninterrupted from midnight to 5:00 a.m. for four consecutive weeks. Moore and Ucko found a rapid progression in the first three months, with the majority of infants meeting their criterion between the ages of 3 to 6 months. Their normative findings are some of the most oft-cited in the infant sleep literature (e.g., Adair et al., 1992; Adair et al., 1991; Anders, 1979; Anders et al., 1983; Armstrong, 1994; Bamford, Bannister, Benjamin, Hillier, Ward & Moore, 1990; Basler, Largo & Molinari, 1980; Blampied & France, 1993; Blurton-Jones et al., 1978; Edwards & Christopherson, 1994; Ferber, 1985; 1987; 1995; 1996; Fergusson et al., 1981; France & Blampied, 1999; France & Hudson, 1990; France et al., 1996; Goodlin-Jones et al., 2000; Jacklin et al., 1980; Johnson, 1991; Kerr & Jowett, 1994; Klackenberg, 1968; Lawton et al., 1991; Lee, 1992; Michelsson et al., 1990; Mindell, 1993; Piazza & Fisher, 1991; Sadeh & Anders, 1993; Scher, 1991; Scher et al., 1995; Schmitt, 1986; Scott & Richards, 1990; St James-Roberts & Plewis, 1996; Wolfson, 1996; Wolfson et al., 1992; Wolke et al., 1994; 1995; Wooding et al., 1990; Zeanah, 1997). Their findings have also been used to provide the basis for the age specific trajectory in France and Blampied's (1999) explanatory developmental models of ISD.

Moore and Ucko's (1957) study has a number of methodological and conceptual flaws making it a potentially poor choice to inform the timing of prevention. These have been described in detail in Chapter Six. In brief, problems with the method include that the developmental data is relatively old; it was obtained from retrospective data; mothers had to recall specific events that had occurred between midnight and 5:00 p.m. over successive days; and, the data was derived from "estimates" of when infant behaviours may have occurred. The conceptual problems pertaining to the criterion included: a 5 hour duration that does not best reflect infant's physiological or behavioural capabilities to sleep uninterrupted; sleep-

disturbed infants may sleep from midnight to 5:00 a.m.; and, it does not reflect parental definitions or expectations of sleeping through the night. These methodological and conceptual problems highlight the requirement for a better criterion of sleeping through the night that is developmentally appropriate, and reflects what infants are behaviourally capable of, and at what age.

In order to establish at what age sleeping through the night does occur further definitions of sleeping through the night need to be examined. A definition incorporating the minimum duration of 8-hours sleep recommended for adults would have greater behavioural meaning, specifically given that infants sleep longer than adults (Ferber, 1985). Eight hours has also been recommended as the minimum duration for uninterrupted sleep for 2-month-old infants (Ezzo & Bucknam, 1995; Ferber, 1985). This duration has been described as increasing to between 10 and 12 hours from 3 months of age (Ezzo & Bucknam, 1995; Ferber, 1985; Schaefer & DiGeronimo, 1995; Symon, 1998), so it should be attainable. However, these recommendations have not been established on the basis of published normative data. There simply are no adequate norms available, hence the aims of this study.

Taking Moore and Ucko's (1957) approach and specifying a time-period, what duration, therefore, best reflects the average attainable for sleeping through the night? The arbitrarily defined hours between midnight and 5:00 a.m. may have been too conservative on the basis even of the durations of the LSP (Anders et al., 1983; Anders & Keener, 1985), whereas the LUSP will in most cases last much longer. Perhaps infants who sleep for 5 hours are also sleeping for longer periods. Perhaps they can sleep for the 8 hours which their parents need. These are issues not yet addressed and will be considered here.

A better criterion more relevant to the needs of parents could be to specify a time period during which an 8 hour duration must occur as this maps more directly onto family needs. The hours between 10:00 p.m. and 6:00 a.m. are one such possibility, as this approaches a more meaningful definition of "night-time". Is this realistic? More developmental data is required to update Moore and Ucko's (1957) findings, to investigate the validity of an 8 hour criterion, and of a criterion occurring between 10:00 p.m. to 6:00 a.m.

An alternative method to Moore and Ucko's (1957) for quantifying the development in sleeping through the night, is by directly examining infants' capabilities for durations of uninterrupted sleep. In this case, rather than predicting the length and timing of the infant's sleep, it can be measured directly, and criteria derived from the normative information. The two approaches investigators use to measure this behaviour were described in Chapter Six. To recap, the LSP, as defined by Anders and Keener (1985) is the longest interval that an infant remains asleep without transitions to wakefulness. It represents an infant's *physiological* capability

to remain asleep, as transitions to wakefulness, which may include an arousal followed by resumption of sleep, is the point at which measurement of the LSP is terminated. It can only be measured by direct observation or polysomnography (e.g., Anders et al., 1983; Anders & Keener, 1985; Anders et al., 1992; Goodlin-Jones et al., 1997; Halpern, et al., 1994).

Considering the LUSP is a better alternative. The LUSP is a measure of the *behavioural* capability for an infant to remain in sleep-related behavioural quietude, and is normally measured by parental report. The LUSP may include arousals with or without transitions to wakefulness which are then followed by self-initiation of sleep, and this is what differentiates the LUSP from the LSP. The LUSP better represents the development of sleeping through the night because it is not bound by a criterion determined arbitrarily by researchers, rather it reflects the attainable nocturnal behavioural quietude.

Few studies have investigated the LUSP, and none have investigated its developments at each successive age in the first 12 months. It has only been studied either across the first four months (Parmelee et al., 1964; Pinilla & Birch, 1993; Wolfson et al., 1992), from 6 months (Jacklin et al., 1980), or at varying ages across infancy (Traisman et al., 1966). While it is difficult to compare the findings of these studies, by 4 months of age, it has generally been established that infants are sleeping for at least 8 hours uninterrupted.

Specifically more developmental data is required on the LUSP for two reasons. First, established durations for the LUSP could serve as a guide for a developmentally appropriate definition for sleeping through the night. Second, establishing when the most rapid developments occur in the LUSP could assist in identifying an optimal time for preventive intervention. That is, preventive intervention could be targeted when the LUSP develops rapidly towards a behaviourally meaningful duration for sleeping through.

Timing of preventive intervention must be derived from normative data but also by using an established diagnostic tool for ISD. Infant sleep disturbance is the obvious outcome measure for preventive intervention. The Sleep Behaviour Scale (SBS) (Richman, 1985) can be employed: (i) as a diagnostic tool that provides a "global" composite sleep score for diagnosing ISD; and, (ii) a tool which can measure relative frequency of scores over the course of development.

The SBS can be employed diagnostically with a normative sample to establish the age when ISD is first evident. By examining longitudinally, the frequency of SBS scores, it may then be possible to identify an age at which a bimodal distribution in the scores occurs. The age where bimodality first occurs indicates the emergence of, if not the manifestation of ISD.

In a bimodal distribution, there are two distinct clusters of scores with tapering off on either side of both clusters (Willemsen, 1974). It is relatively easy to detect this phenomenon, for example, such looking at either a graph of the frequency distribution of the SBS scores. Willemsen stated that the focus of interest should be on what the bimodality means. In the case of ISD, a cluster of lower scores will represent a group of infants with settled sleep, and a cluster around higher scores will represent a group with disturbed sleep patterns. The SBS score is the variable that operationally defines the two groups at the point where bimodality occurs. Establishing the existence of discrete groups will allow the use of statistics to investigate factors which predict membership in each group.

Scores on the SBS have no validity as a measure of ISD prior to 6 months of age, however they can still provide important information on sleep pattern development prior to and after 6 months. By using the SBS longitudinally two critical pieces of developmental information may be gained:

1. The distribution and "shift" in scores over time and how this reflects the SBS developmental function.
2. The stability of sleep patterns from early infancy through until the end of the first year.

When investigating the developmental changes in SBS scores, it is necessary to address any factors that may have affected the scores. Parents who intervene in an attempt to manage what they perceived to be a disturbed pattern of infant sleep, is one possible moderating factor. If parents do initiate any attempts at intervention, as previous research has confirmed (France, 1989) that they do, were these attempts then successful in improving the infant's sleep pattern? If these attempts were successful, then how do infant's pre and post-intervention SBS scores compare with the those of infants whose parents did not intervene, where changes in scores are mainly accounted for by maturation?

The primary aim of the study was to identify the optimal timing for preventive intervention of ISD by identifying at what age infants are most likely to sleep through the night. This aim would also serve to test France and Blampied's (2000) models and the predictions of specific age-related developments (derived from Moore and Ucko's 1957 findings), thereby providing a theoretical basis to support intervention. This primary aim was divided into four subaims in order to:

1. Establish norms for sleeping through the night.

This would allow Moore and Ucko's (1957) definition, the utility of an "8 Hour" criterion, and the criterion of 10:00 p.m. to 6:00 a.m. to be evaluated.

2. Examine the Moore and Ucko (midnight to 5:00 a.m.) criterion, an "8-hour" criterion, and a 10:00 p.m. to 6:00 a.m. criterion.

This would clarify the utility of each criterion, establish the age infants are likely to begin sleeping through the night, and the age at which the majority of infants are doing so.

3. Describe changes in the LUSP over the first year.

Thus, in order, to establish the durations infants are capabilities of and when the most rapid developments occur.

4. Investigate the developmental function and stability in the SBS scores over the first year of life, and identify any factors that may have affected this.

Further to this aim is to identify ages demonstrating a bimodal distribution of SBS scores. This will allow a group of infants with settled sleep and a group without to be identified.

10.2. METHOD

10.2.1. Design

This was a descriptive research study that employed a prospective longitudinal design with repeated measures.

10.2.2. Participants and Setting

The participants and setting for the study are as described in the Method Section (Chapter Nine).

The initial aim was to recruit the infants at 1 month of age, however, the sample ended up consisting of 52 infants whose parents returned a diary in their first month, and 23 whose parents completed and returned the first diary for the infants in their second month. The infants recruited at 1 and 2 months have been included together in the data, and treated as one group. This decision was based on a finding of no significant differences observed in t-tests between the two groups at age of entry for the variables of greatest interest in the analysis. These were the mean age for sleeping through the night, and the SBS scores at 2 and 6 months of age (see Appendix H).

10.2.3. Measures

The measures employed for Study One are also as described in Chapter Nine.

The dependent variables extracted from the Sleep Diaries for the LUSP, and the SBS are as described and defined in Chapter Nine. In addition to these, there are three definitions for sleeping through the night. In all cases criteria had to be met for 5 out of 6 nights of the week, or for 80% or more of occasions if less than 6 days of data were provided.

1. Moore and Ucko (1957) criterion: Sleeping uninterrupted from midnight to 5:00 a.m.
2. 8-hour criterion: Sleeping uninterrupted for 8 hours between sleep-onset (first substantial period of quiet at night) and time awake in the morning.
3. 10:00 p.m. to 6:00 a.m. criterion: Sleeping uninterrupted for a period of 8 hours from 10:00 p.m. to 6:00 a.m.

10.2.4. Data Analysis Procedure

The specific manner in which the data were collected was described in Chapter Nine. The procedures by which the data was treated in each section of the results are described below.

10.2.4.1. Sleeping Through the Night: Correcting for Missing Data

In order to compare Moore and Ucko's (1957) cumulative data with the present study, a formula was derived to calculate the cumulative proportions at each age and account for the missing data. As described in Chapter Nine in a few cases diaries were not returned. Because of missing data, the raw data of the total sample was corrected by the following the three steps:

1. For each separate age point the number of infants who met the criterion for the first time was calculated.

2. Missing data and never meeting the criterion over the period of the study:

For each separate age point the number of infants who had missing data, and who *never met the criterion in the 12 months* were included in the total n of the sample (the denominator) at each age point. It was presumed that these infants did not meet the criterion at this age point.

3. Missing data at one age but meeting the criterion at a later age.

For each separate age point, the number of infants who had missing data, *but, met the criterion at a later age*, were subtracted from the total sample for that specific age point. This was a conservative approach, because until the infant had been shown to met the criterion only then could he or she be entered as meeting the criterion at the matching age.

Cumulative proportions were then calculated at each of these three steps. The same method was employed to establish the cumulative percentage of infants who met the "8-hour" criterion, and the 10:00 p.m. to 6:00 a.m. criterion.

10.2.4.2. Examining the Moore and Ucko (1957) (Midnight to 5:00 a.m.) Criterion, the "8-Hour" Criterion, and the 10:00 p.m. to 6:00 a.m. Criterion by Using Survival Analysis

A survival analysis was conducted to establish the likelihood of infants meeting each criterion over the first 12 months and in order to compare the criteria. In brief, survival analysis measures the length of time (survival) until occurrence of an event.

Survival analysis is a very useful technique when the outcome of interest is the time until some event happens. It is more powerful than simply counting how many events occur in each group and provides useful information about the course of a disorder.

(Streiner, 1995, p. 444)

The length of time to the occurrence of the event, in this case the onset of meeting the criterion, was entered for each infant. Survival time was taken as the age at which the infant met the criterion. Those infants who had not met the criterion before the end of the study were entered as censored data (Singer & Willett, 1994). This study employed three components of survival analysis, these are:

1. The survivor function which separates the time to meeting the criterion into intervals and indicates the probability of not meeting the criterion for sleeping through beyond a specific period of time.
2. The estimated median lifetime which indicates the time by which half of the sample have met the criterion (Singer & Willett, 1994).
3. The hazard function which demonstrates the proportion of individuals within each interval who had met the criterion, out of all those who entered the interval, or still had not met the criterion. The hazard represents the "risk" of the event's occurrence in each time period. In survival analysis, the term risk is neutral. It refers to the event of interest which may be a negative behaviour/experience, such as death and disease, or it may be positive. In this study the event of sleeping through the night is considered positive, but the term "risk" still applies, and is defined as the chances of meeting the criterion of sleeping through the night in a particular time period. Comparing the hazard at different time periods helps identify the particularly "risky" times, i.e., when infants are most likely to sleep through the night.

10.2.2.3. The LUSP

For each diary at each age point, the LUSP, and start time of the LUSP for each diurnal period was identified. A mean LUSP (in minutes) and mean start of LUSP (in 24 hour clock) for each age was then calculated. The results of the mean LUSP are reported in minutes with equivalent time in hours and minutes in parentheses.

To establish when the LUSP occurred during the 24 hour period, it was coded as either occurring during the day or the night. Night was defined as starting after infants are placed into bed for the night. In order for it to be predictably located in one or

other of these periods the LUSP had to occur at this point on 5 of 6 nights, or 80% of occasions when parents completed less than 6 days of the diary.

10.2.4.4. The SBS

The composite sleep behaviour score for each infant was computed from each set of sleep diaries returned. Scores on six individual items were summed to give a score of 0-24, with 24 representing more sleep disturbance.

Frequency and bimodal distribution of scores: The frequency distribution graphs of SBS scores were analysed to determine if a bimodal distributions of score occurred defined as *where two distinct clustering of scores with tapering off*, on either side of both clusters (Willemsen, 1974). The score where the bimodality occurs is the cut-off score to describe the two discrete groups. Descriptive statistics are then employed to compare differences between the two groups' mean SBS scores during the course of the study.

Stability of SBS scores: To investigate the stability of SBS scores a Pearson's correlation coefficient was calculated of 73 infants' SBS scores was conducted at 2, 6 and 12 months of age. These ages were chosen because they comprised the highest number of infants for whom diaries were available across the study.

Parent intervention data: Some of the infant's SBS scores were affected by parent-initiated intervention (parent intervention group). The data of these participants were analysed separately to establish if there were any significant differences between the mean pre-and post-intervention SBS scores. The scores of infants whose parents did not intervene are presented at comparable ages to the parent intervention infants scores at pre-and post-intervention. These comparable ages were chosen because a mean age cannot be calculated for comparison against the "parent intervention" group.

10.3. RESULTS

The analysis is divided into five sections. The first describes the characteristics of the data received. The second section presents normative data on sleeping through the night according to the three different criteria. In the third section the utility of three criteria for sleeping through the night are examined according to how they inform when infants are likely to sleep through the night. The fourth section describes the changes in mean LUSP across the first 12 months of life. The fifth section describes developmental changes in SBS scores.

10.3.1. Section One: Characteristics of the Data

Table 14.

Number of diaries received for infants at each age over the first 12 months.

		AGE IN MONTHS												
		1	2	3	4	5	6	7	8	9	10	11	12	F/U
N	Infants	52	75 ¹	75	75	75	75	75	75	75	75	75	75	53
N	Diaries	52	74	68	70	66	75	59	67	70	59	54	74	53
% ²		100	99	91	93	88	100	79	89	93	79	72	99	70

Note. ¹ 23 participants entered the study at this age

² represents the proportion of available diaries returned

A minimum of 787 sets of diaries were collected during the course of the study, which totalled to just over 4250 days of data. Table 14 shows the number and percent of infants for whom diaries were returned at each age. There was a high percentage return of diaries over the 12 age points, ranging from 72% to 100% of the diaries sent out. The figures show that the lowest rate of return was at 11 months (72%). During the study, the parents of 1-month-old infants completed a mean number of 11 diaries out of a possible 12, those who entered the study at 2 months completed a mean of 10 out of a possible 11. The rate of return of the diaries was high in contrast to the 46% reported in the most recent New Zealand normative study on infant sleep (Wooding et al., 1990). The return rate was however

comparable with the 88% reported in a longitudinal study conducted in Israel by Scher (1991).

Parents were asked to provide reasons for missing diaries. These included: (i) settled sleep was assumed to be of no interest to the study (n=10); (ii) parents forgot (n=18); (iii) it was an inconvenience (n=11); (iv) infants were ill (n=19); (iv) diaries were posted but not received by the researcher (n=15).

10.3.2. Section Two: Sleeping Through the Night

Figure 2 shows the cumulative proportion of infants who met Moore and Ucko's (1957) criterion for sleeping uninterrupted from midnight to 5:00 a.m. at each chronological age in the first year. It also shows the percentage of infants in the Moore and Ucko study who met the criterion at successive ages.

The steepest increase in slope over the 12 months occurred across the first 3 months when over half (55%) of the infants had met the criterion. Within this initial three month period, the most rapid progression, and steepest slope occurred from 12% at 1 month of age to 44% at 2 months of age demonstrating an increase of 32%. Such a rapid increase was not repeated again between any two age points. From the ages of 2 to 3 months there was an increase of 11% with 55% of the infants sleeping through. From 3 to 6 months of age, the slope flattened and the proportion increased to 76%. From 7 to 12 months of age there was a minimal increase: 76% to 87%. By 12 months 13% of the infants had never met the criterion throughout the first year. Compared with the present study, Moore and Ucko (1957) had consistently higher figures at each age, although from 9 to 12 months of age no infant in their study met the criteria for sleeping through.

Figure 3 shows the cumulative proportion meeting three different criteria for sleeping through the night. Visual analysis demonstrates a similar trend in the age related changes across the 12 months for each criterion. Of the three, a higher proportion of infants at each successive age met Moore and Ucko's criterion for sleeping through, followed by the 8-hour criterion, and then the 10:00 p.m.- 6:00 a.m. criterion. By 12 months there was a 1% difference between the infants who met Moore and Ucko's (1957) criterion and the 8-hour criterion, 87% and 86%, respectively. In contrast, fewer infants met the criterion of 10:00 p.m. to 6:00 a.m. at each age point, with 74% sleeping through according to this criterion at 12 months.

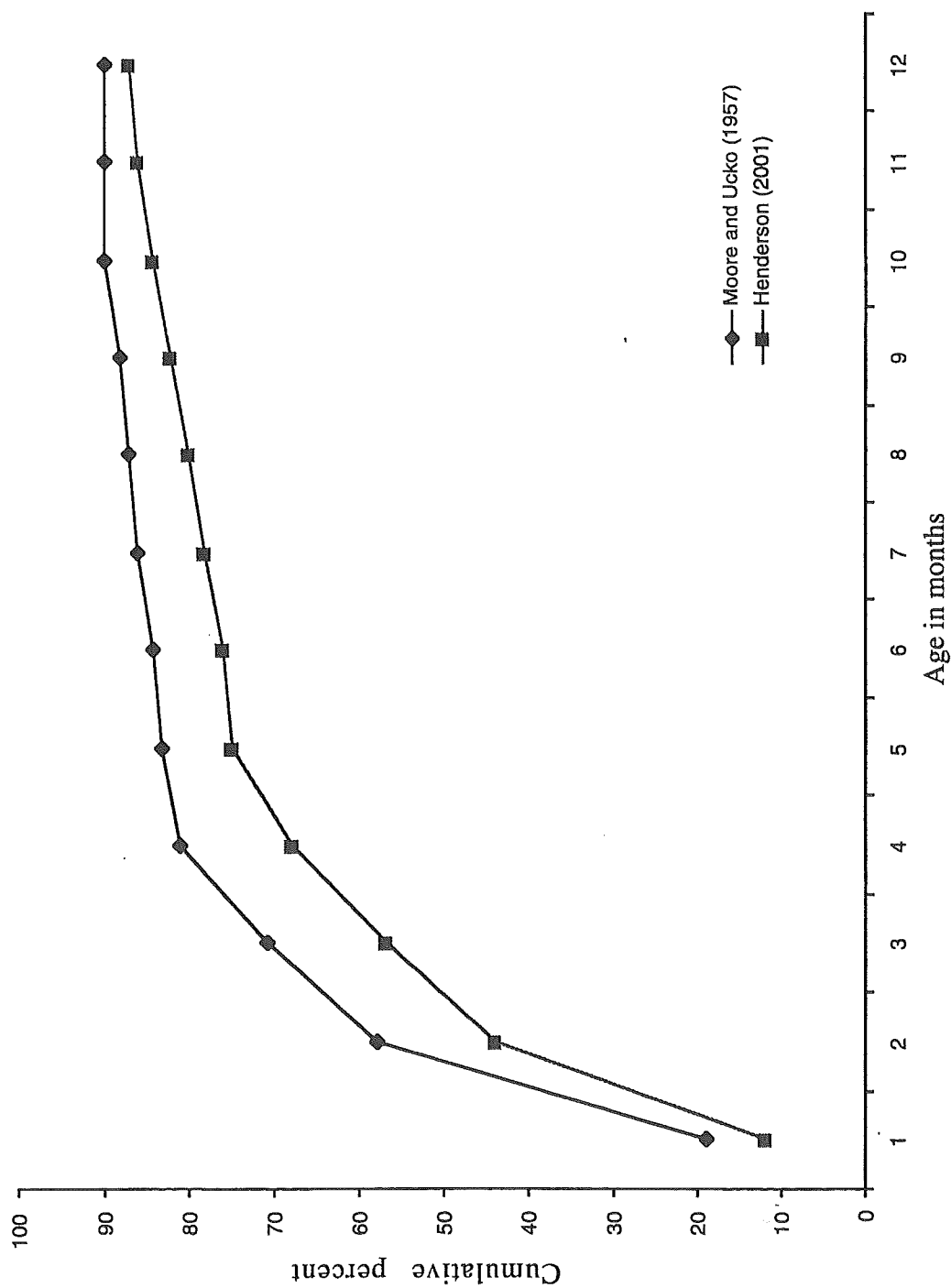


Figure 2. The cumulative percentage of infants who met the Moore and Ucko (1957) criteria over the first year of life

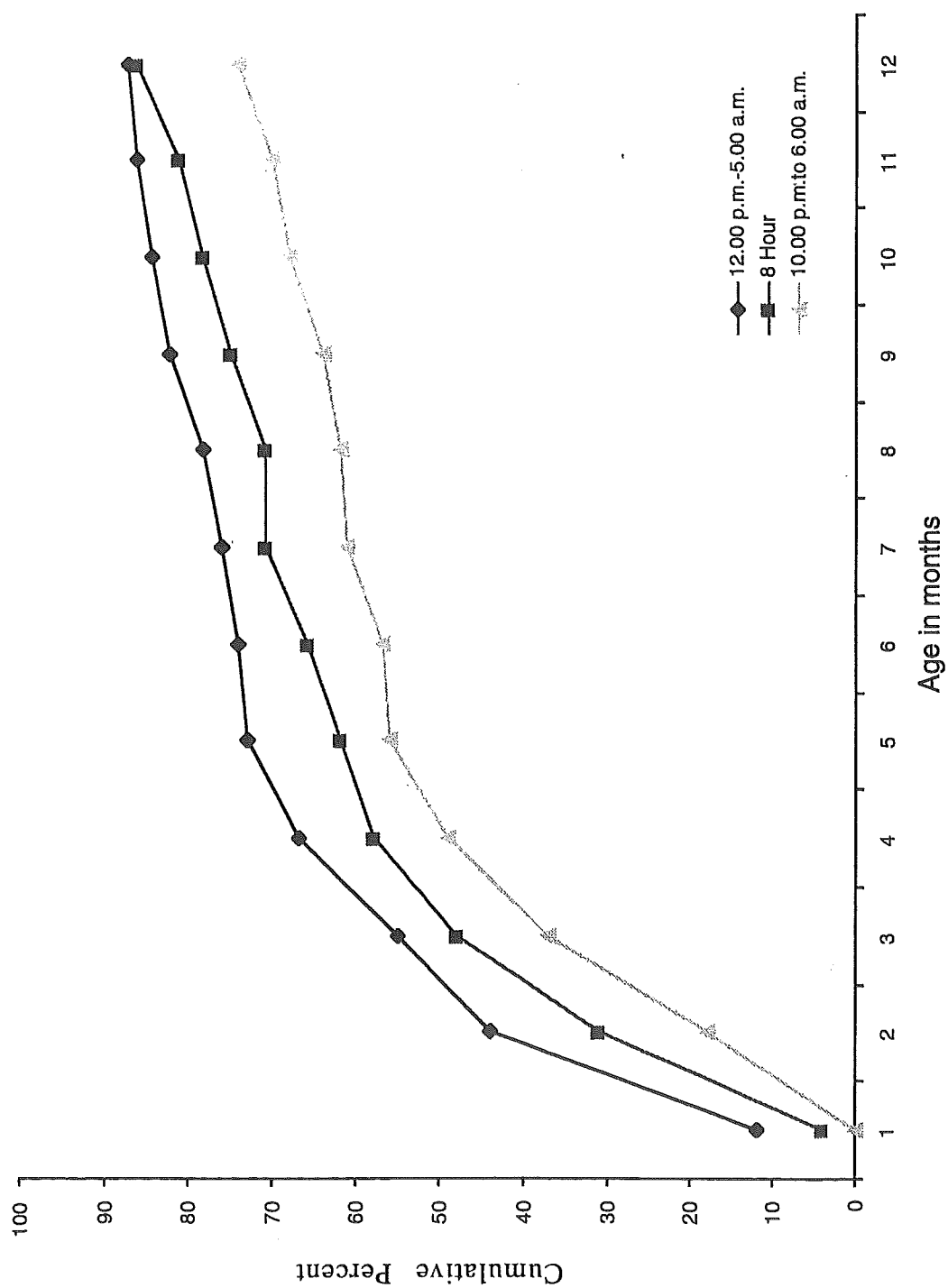


Figure 3. The cumulative percentage of infants who met the three criteria over the first year of life.

From 1 to 2 months of age the largest increase occurred in the proportion of infants who meet both the Moore and Ucko and the 8-hour criterion, 32% and 19% respectively. For this latter criterion, there was a similar proportional increase of 17% from the ages 2 to 3 months. For the 10:00 p.m. to 6:00 a.m. criterion the largest increase (19%) occurred later from 2 to 3 months. So by 4 months, 67% (Moore & Ucko, 1957), 58% (8-hour), and 49% (10:00 p.m. to 6:00 a.m.) of the infants had met the criteria. From 5 to 12 months there was a minimal but sustained increase in the cumulative proportion of infants who met each criterion with the largest increase (24%) for the 8-hour criterion. By 12 months of age the cumulative proportion of infants who had met Moore and Ucko's (1957), the 8-hour, and the 10:00 p.m. to 6:00 a.m. criteria was respectively 87%, 86% and 74%.

10.3.3. Section Three: Comparison of Three Different Criteria for Sleeping Through the Night

Comparing survival times of the three criteria:

A survival analysis was conducted to determine if there were any significant differences between when infants met each of the three criteria. This analysis uses Gehan-Wilcoxon test, a non-parametric test of significance. This was used to compare the survival times for each criterion. The cumulative proportions of infants meeting the three criteria were plotted and each compared against the other. Comparisons shown in Figure 4 include Moore and Ucko's (1957) criterion compared with the 8-hour criterion and the 10:00 p.m. to 6:00 p.m. criterion, and the 8-hour criterion was compared with the 10:00 p.m. to 6:00 a.m. criterion. The Gehan-Wilcoxon test has been reported for each comparison in Table 15.

Table 15.

Comparisons of the three different criteria using the Gehan Wilcoxon test.

CRITERION	GEHAN WILCOXON	P VALUE
Moore and Ucko vs. 8-hour	-1.07	.28
Moore and Ucko vs. 10:00 a.m. - 6:00 a.m.	-2.96	.003
8-hour vs. 10:00 a.m. - 6:00 a.m.	-2.02	.04

The time in months until infants meet the 10:00 p.m. to 6:00 a.m. criterion is significantly longer, than both the Moore and Ucko (1957) ($p < .01$) and the 8-hour criteria ($p < .05$). There is no significant difference between the time in months taken for infants to meet the Moore and Ucko and the 8-hour criteria ($p = .28$).

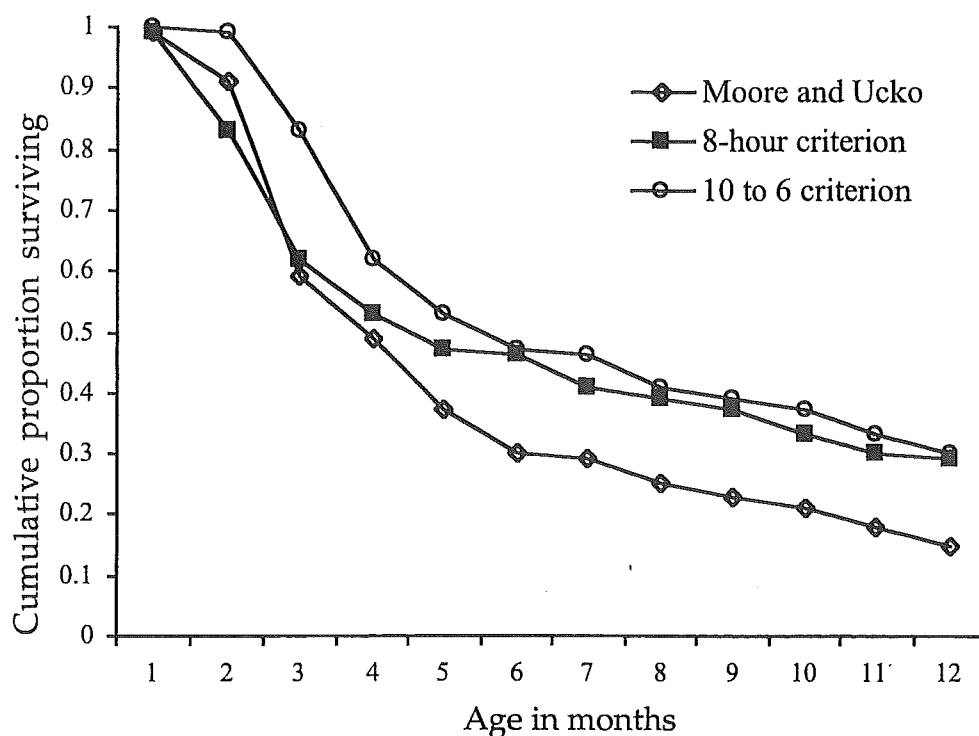


Figure 4: Cumulative proportion surviving under each criterion.

10.3.3.1. The Onset of Sleeping Through the Night: Survival and Hazard Functions for Each of the Three Criteria

The survivor and hazard functions were calculated to establish: (i) the probability that an infant would still be waking at a particular month, and the median age at which infants sleep through the night under each criterion (survivor function); and (ii) the age at which highest probability of onset of sleeping through the night occurs (hazard function).

A life table of the survival data for the total sample which includes the survival probability and hazard function for each time period for the Moore and Ucko (1957), 8-hour and the 10:00 p.m. to 6:00 a.m. hour criteria is presented in the Appendix I.

10.3.3.1.1 Survival analysis for the Moore and Ucko (1957) criterion (total sample)

In the top panel of Figure 5 at the beginning of the study the survivor function shows 99% of the infants were still awakening during the night (i.e. surviving), hence the survival probability was .99 for meeting the criterion. Over time periods, as infants met the sleeping through criterion, the survival probability steadily dropped towards zero. The survival function drops off most sharply at 2 months. So 2 months is the time that infant are most likely to meet the Moore and Ucko (1957) criterion.

Also shown in Figure 5 is the estimated median survival lifetime (i.e. where the probability of meeting the criteria is 0.5). This occurs in the third month, so by this time half of the infants are sleeping uninterrupted from midnight to 5:00 a.m..

The bottom panel of Figure 5 shows the hazard function. The hazard for each time period is plotted. This indicates that the highest "risk" (i.e. "risk" of sleeping through the night) according to Moore and Ucko's (1957) criterion was during the second period (2 months of age) when the hazard graph is most elevated.

10.3.3.1.2. Survival analysis for the 8-hour criterion (total sample)

In the top panel of Figure 6 the survivor function drops off sharply at 2 months, and again although not as steeply at 3 months. So, at 2 months followed by 3 months is when infants are most likely to meet the 8-hour criterion.

Also shown in Figure 6 is the estimated median survival lifetime. This occurs at the end of the third month, so by this time half of the infants are sleeping uninterrupted for 8-hours.

The bottom panel of Figure 6 shows the hazard function. Again this indicates that the highest "risk" according to the 8-hour criterion was during the second period (2 months) when the hazard graph is most elevated.

10.3.3.1.3. Survival analysis for the 10:00 p.m. to 6:00 a.m. criterion (total sample)

As shown in the top panel of Figure 7 from 1 to 3 months there was little decline in the survival function, then it drops off sharply at 3 months. So 3 months is when infants are most likely to meet to the criterion of sleeping through the night from 10:00 p.m. to 6:00 a.m.

Also shown Figure 7 is the estimated median survival lifetime which occurs half way through the five month period. By this time period half of the infants are sleeping uninterrupted between the hours of 10:00 p.m. to 6:00 a.m.

The hazard function (Figure 7) indicates that the highest "risk" according to 10:00 p.m. to 6:00 a.m. criterion was during the third period (3 months).

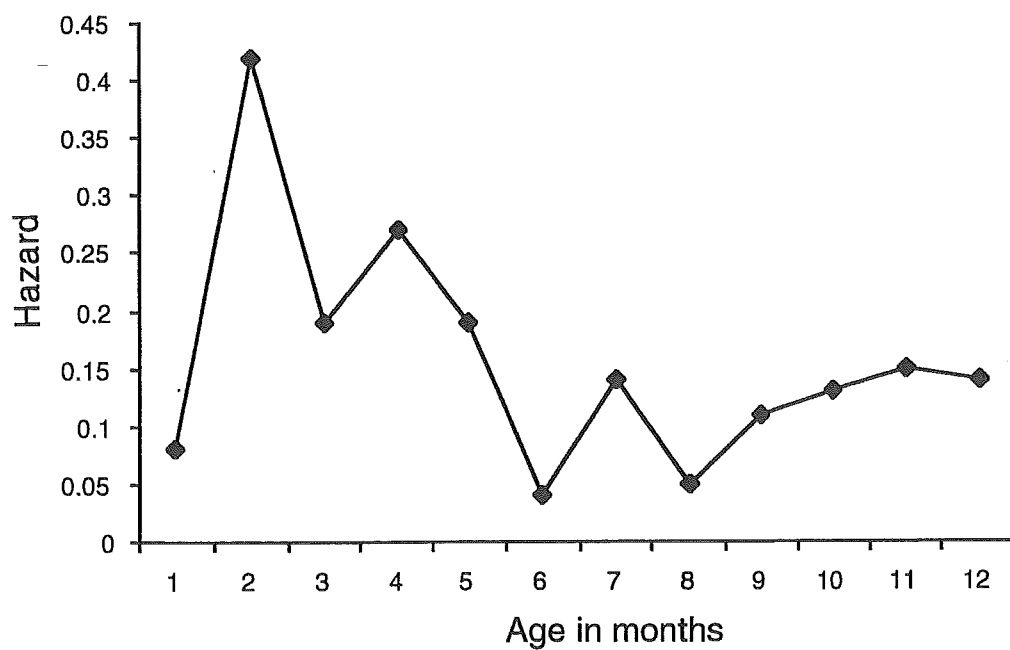
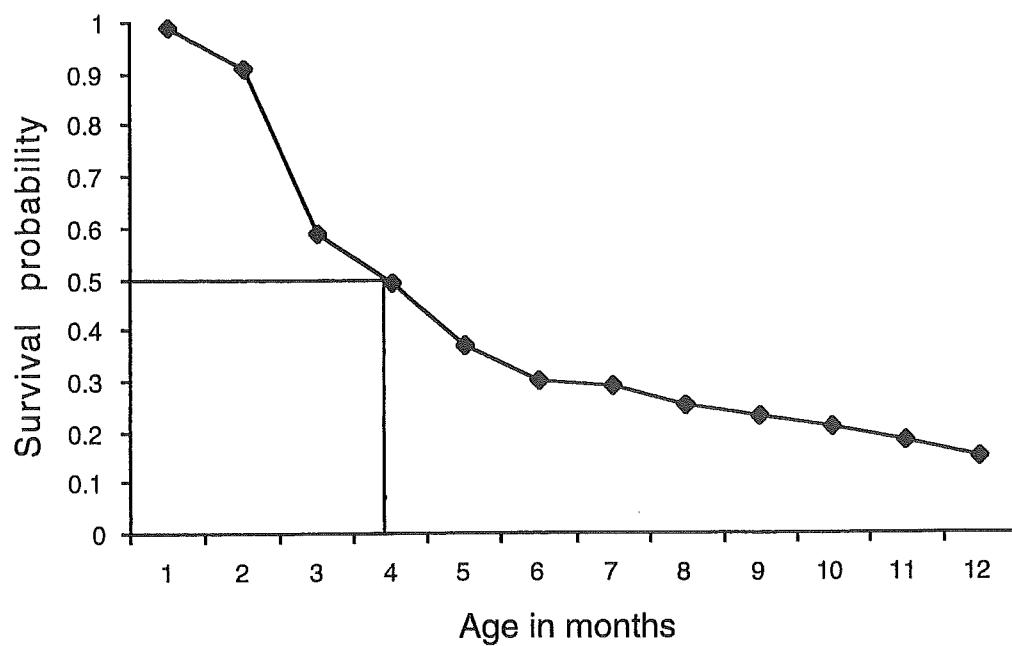


Figure 5. Survivor and hazard functions for the Moore and Ucko criterion.

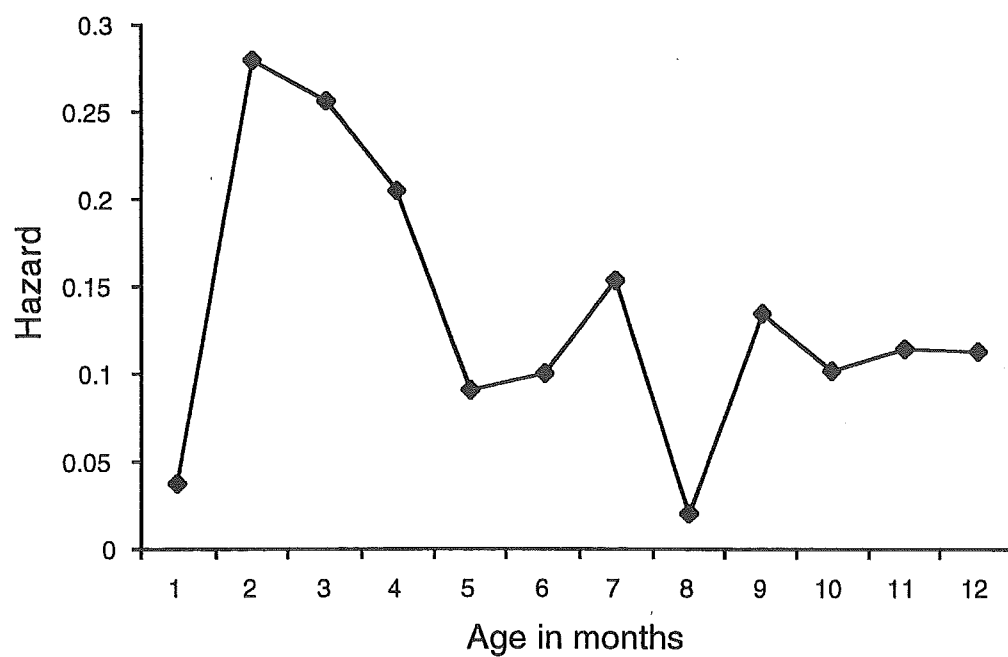
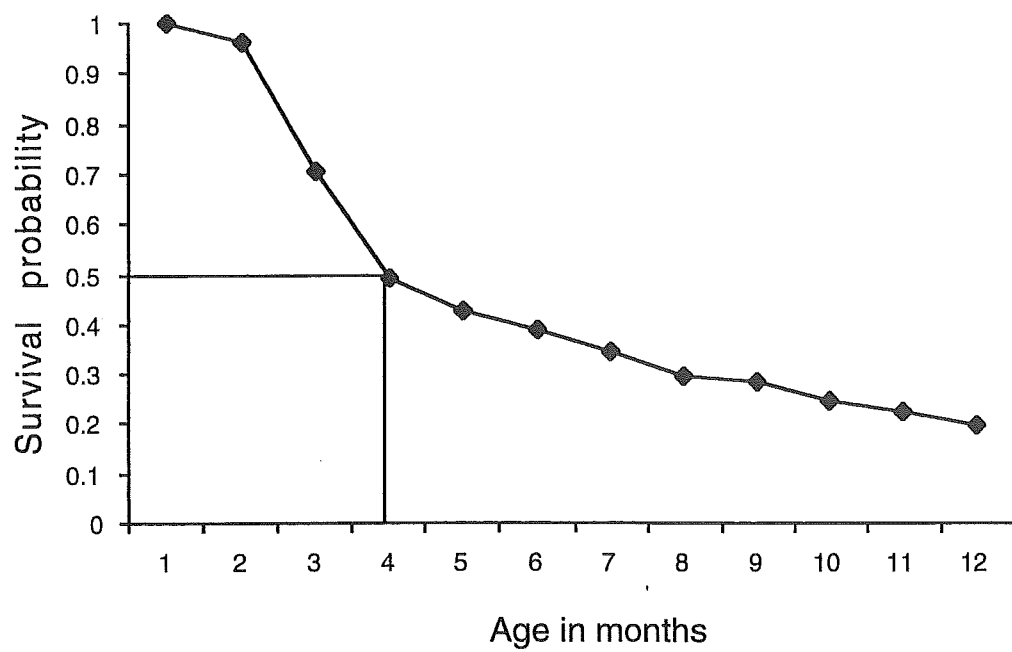


Figure 6. Survivor and hazard functions for the 8-hour criterion.

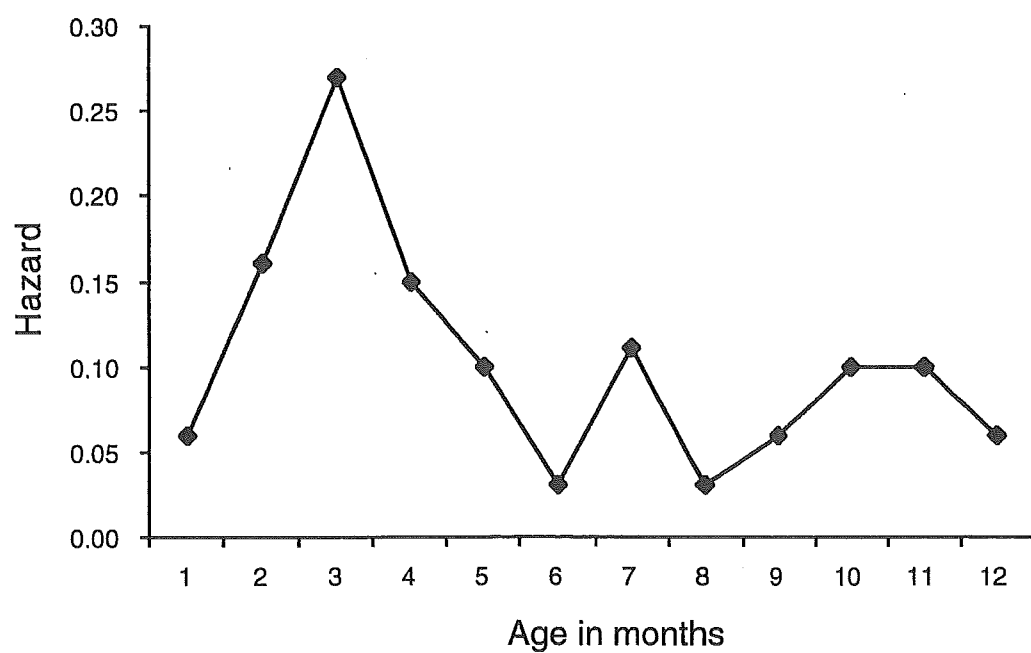
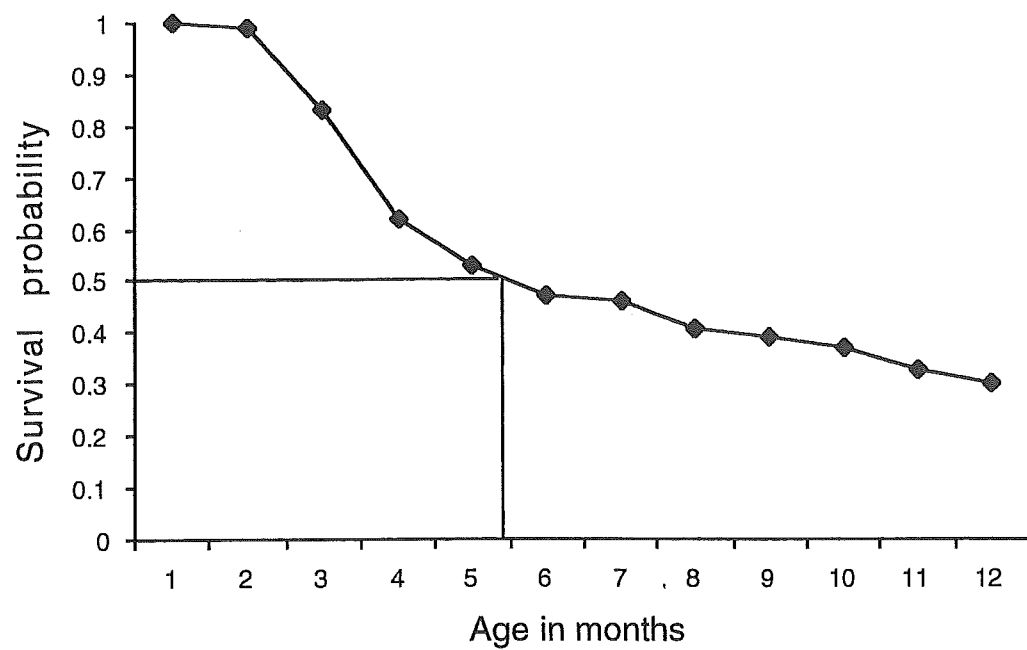


Figure 7. Survivor and hazard functions for the 10:00 p.m. to 6:00 a.m. criterion.

10.3.4. Section Four: The Longest Uninterrupted Sleep Period

Figure 8 plots mean LUSP duration, and mean LUSP start time over the first 12 months of life. The largest increases in the duration of the mean LUSP was from 1 to 3 months. Over the 12 age points the greatest increase in LUSP duration was from 1 to 2 months (326.0 min/5.4 hr to 439.0 min/7.3 hr) demonstrating an increase of 1.8 hr. The second largest increase occurred from 2 to 3 months (488.3 min or 8.4 hrs) demonstrating an increase in duration of 42 minutes.

Between the ages of 4 to 9 months the mean LUSP duration increased only 29 minutes, ranging between 500.0 - 529.0 min. At 9 months the mean duration fell minimally below the 4 month mean, but still remained longer than 8 hours. From 9 to 12 months there was a steady increase in the duration of the LUSP from 529.0 min (8.8 hr) to 576.6 min (9.6 hr).

Figure 8 also shows the mean start time for the onset of the LUSP. The mean start time decreased over the first 12 months. At 1 month the mean onset time was 10:30 p.m. which rapidly decreased by 1 hour to 9:30 p.m. at 3 months. By 12 months the mean onset time for the LUSP had decreased to 8:30 p.m.

At each age point across the first 12 months the LUSP occurred during the night.

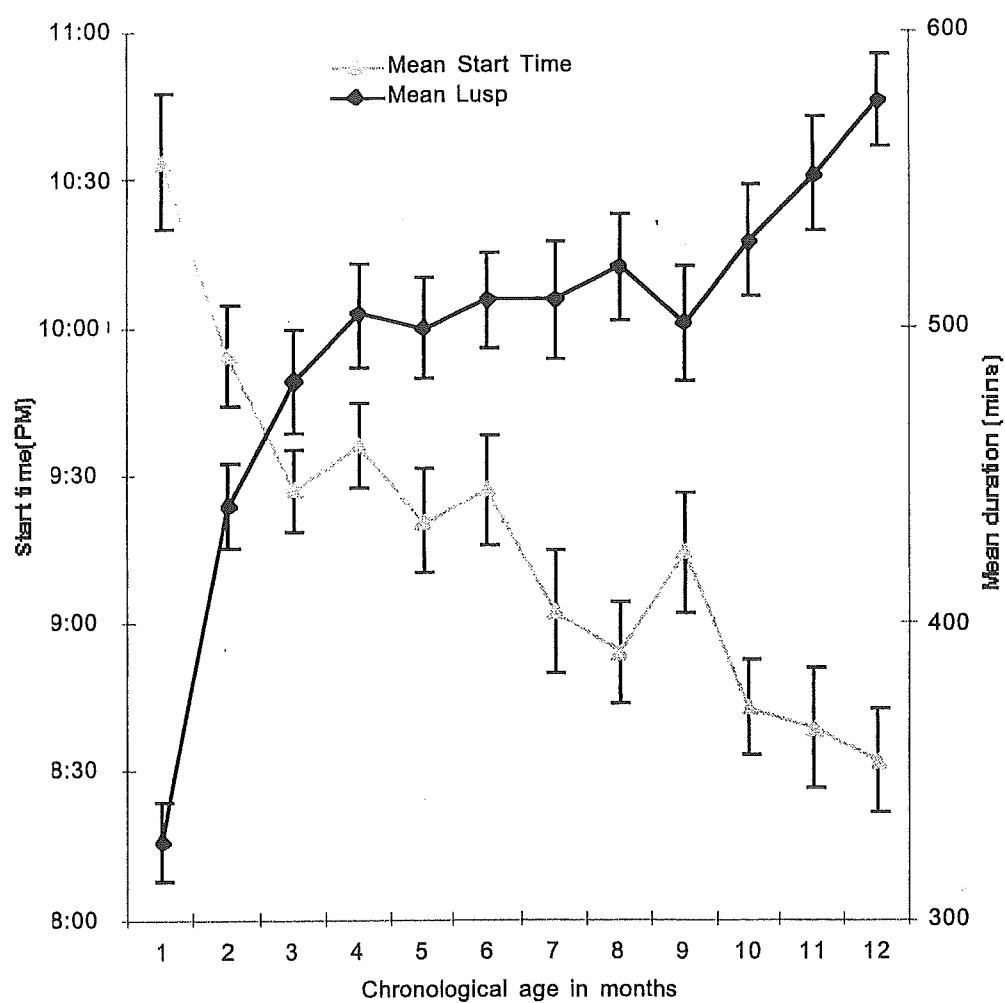


Figure 8. Mean start time and the mean LUSP in infants.

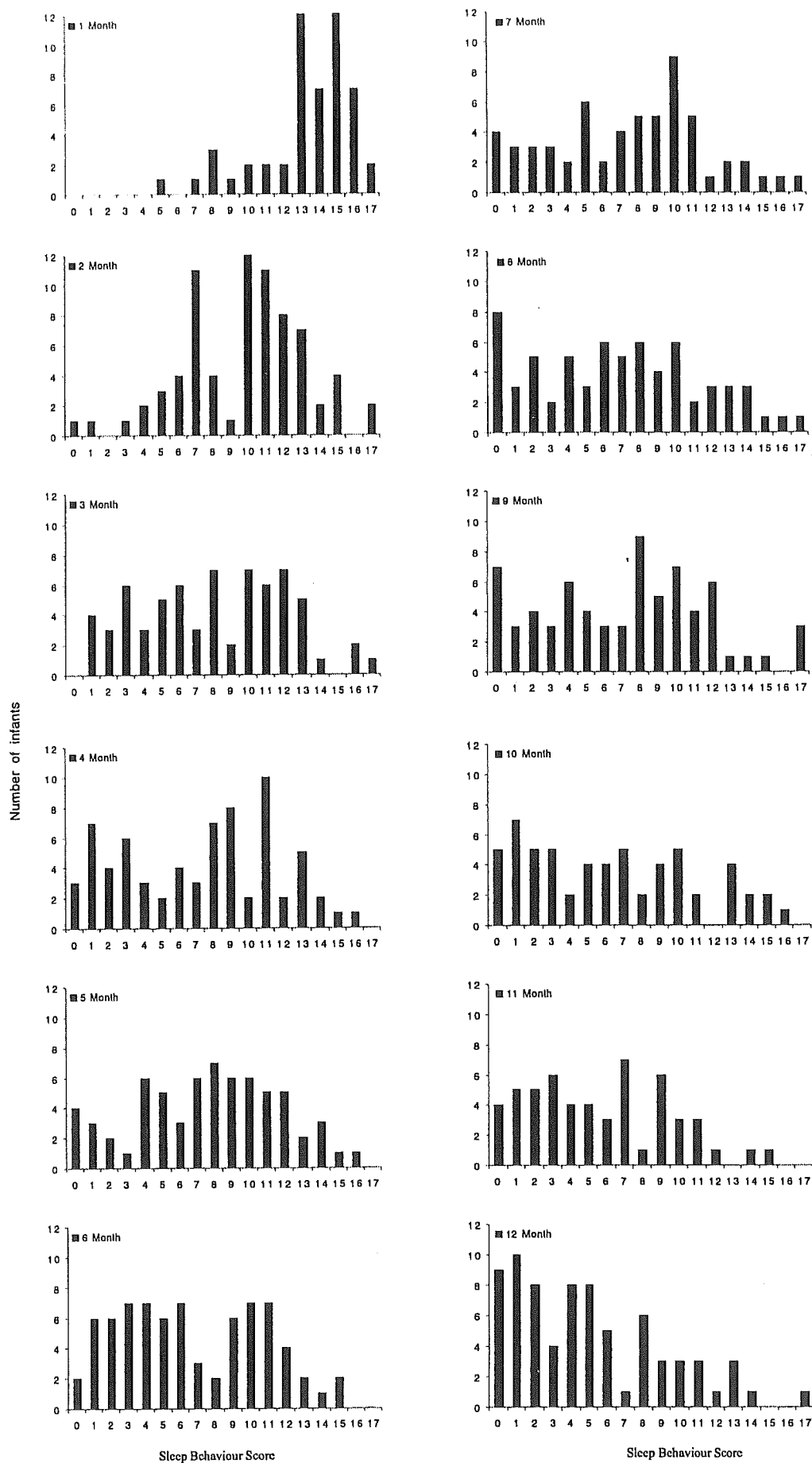
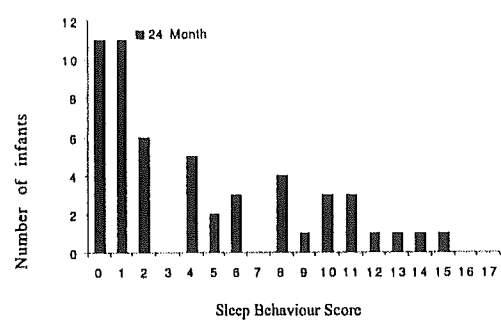


Figure 9. Distribution of SBS scores over the first 12 months, and at the 24-month follow-up.

Figure 9. Continued

10.3.5. Section Five: Distribution of Sleep Behaviour Scores

The data were analysed to describe the distribution of SBS scores from 1 to 12 months, and again at 24 month follow-up. This was to establish the age when the distribution clearly distinguishes between a group with settled sleep and a group without.

10.3.5.1. Distribution of SBS Scores

Figure 9 shows the distribution of SBS scores at each age for the first 12 months. At 1 month there is a skewed distribution in the scores towards higher scores. In the second month the distribution has separated so that more scores are concentrated in the higher range, while a number of scores have shifted into the lower range. The scores in the lower ranges taper off on either side of the score of 7. The distribution then widens, so that by 3 months there is no obvious skew toward either very high or low scores.

At 6 months a clear bimodal distribution of scores is first evident, i.e., there are 2 distinct clusters of scores with tapering off on either side of both clusters. One group of scores clusters between 8 and 15 (mean = 10.8), and the other group clusters between 0 and 7 (mean = 3.8).

At 9 months the majority of scores are distributed between 0 and 7. At 12 months there is a skewed distribution in the scores towards the lower scores but there is a bimodality of sorts with a discrete group of infants who score in the higher ranges, and a group who score in the low ranges.

10.3.5.2. Mean SBS Scores for the NSD and the SD Groups

In Figure 9, a score of 8 separated the bimodal distribution at 6 months. This score will therefore be used to differentiate between 2 groups, so that infants who achieved a score greater than 7 are referred to as the (emerging) Sleep-Disturbed group (SD), and infants who achieved a score below 8 are referred to as the Non-Sleep-Disturbed group (NSD).

As shown in Figure 10, compared with the mean SBS scores of the SD group, from 1 to 12 months, and at follow-up, infants in the NSD group had lower mean SBS scores at each age point. When comparing the trends in the means of the two groups, visual analysis shows a small difference at 1 month of age. From 2 to 4 months, the difference between the groups' means increases, mainly because of the rapid decrease in the mean scores of the NSD group. Between 4 and 9 months there was consistent range in the difference between the SBS means of the two groups, with the NSD group achieving mean SBS scores of 4, and the SD group achieving a means SBS scores of 10. From 10 to 12 months the means of both groups decreased. The means of the SD

group did not decrease at follow-up, while the means of the NSD group further decreased.

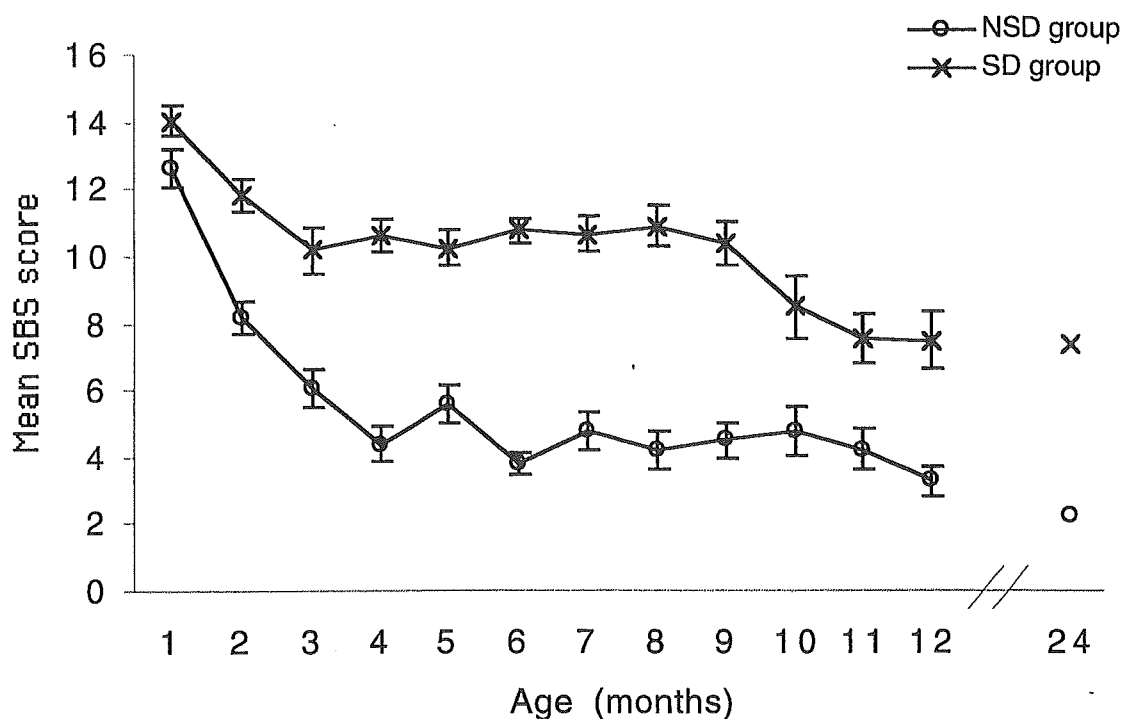


Figure 10. Mean SBS scores and standard errors for NSD and SD groups from 1 month to 24 month follow-up.

10.3.5.3. Stability of SBS Scores

Table 16.

Correlations for all infants between 2, 6 and 12 months.

Correlations		
2 to 6 months (n=74)	6 to 12 months (n=73)	2 to 12 months (n= 74)
.59*	0.55*	0.34*

*all correlations significant at .01 level

Table 16 shows a significant correlation for each set of ages. There was a significant correlation between scores at 2 and at 12 months. The strongest relationship of scores is between 2 and 6 months ($r=.59$).

10.3.5.4. Mean SBS Scores Before and After Parent-Initiated Intervention

Table 17 shows the data for two groups of infants separated by age, the "Less than 6 months" group represents infants whose parents intervened prior to 6 months, the "6 months and older" group represents infants 6 months and older, whose parents intervened. The mean ages when parents intervened for both groups of infants, and the mean SBS scores pre-and post-parent-initiated intervention are shown in Table 17. These are then compared with the mean SBS scores of infants at comparable ages whose parents did not intervene as shown in Table 18 and whose scores therefore represent the effect of maturation. The different types of management attempts by parents are tabled Appendix J.

Table 17 shows for both age groups, parents who intervened in their infants sleep behaviour produced a significant change from pre to post SBS scores. For infants less than 6 months of age, parents intervened with their infants at a mean age of 3.9 months, and produced a significant decrease in the mean SBS score. The post-intervention mean SBS score shown in Table 17 was 7.5, almost matched the mean SBS score of 7.2 for 3-month-old infants whose parents did not intervene at this age shown in Table 18. Table 18 shows the maturational change in scores from comparable age pre-and post-intervention phases were not as large as those demonstrated in Table 17 for the parent-intervention group.

Table 17.
Pre-and Post-intervention SBS scores: Parent intervention.

Parent Intervention				
	Less 6 Months (mean age 3.9 months, sd 1.3) (n=11)		6 Months and older (mean age 9.3 months, sd 1.4) (N=15)	
	Pre -intervention SBS score	Post- intervention SBS score	Pre- intervention SBS score	Post- intervention SBS score
Mean	11.0	7.5**	9.9	6.5***
(sd)	(2.5)	(3.9)	(2.1)	(3.3)

Note. ** P<.01, *** P<.001,

Table 18.
Comparison table for Table 17: SBS scores for infants without parent intervention at comparable pre-and post-intervention ages.

No Parent Intervention				
	Equivalent age pre and post SBS scores (n=64)		Equivalent age pre and post SBS scores (n=60)	
	3 Months	5 Months	9 Months	11 Months
Mean	7.2	6.2	5.6	4.6
(sd)	(4.1)	(3.8)	(3.8)	(3.4)

Table 17 shows that for infants 6 months and older, following parent-initiated intervention there was a significant decrease in the SBS scores. The post-intervention mean SBS score of the intervention group decreased to 6.5 which is shown in Table 17 to be 1 score above the comparable pre-intervention score of 5.6. It is 2 scores higher than at the equivalent post-intervention score at 11 months. Table 18 also shows that the change in scores for infants over 6 months in age from comparable age pre- and

post-intervention phases were not as large as those demonstrated in Table 17 for the parent-intervention group.

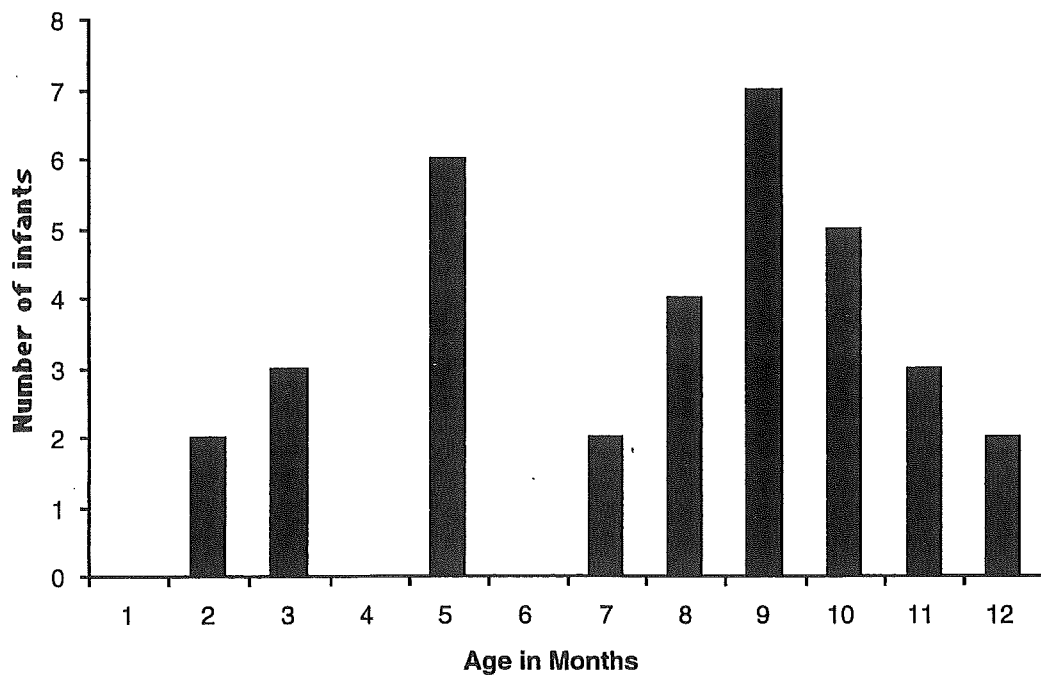


Figure 11. Infant age when parents initiated intervention.

Figure 11 shows the number of infants whose parents intervened at different ages in the first 12 months. Of the 15% of parents who intervened prior to 6 months, the majority did so at five months. Of the 21% who intervened after 6 months, the most common age was 9 months, followed closely by 10 and 8 months.

10.4. DISCUSSION

The results of this study have identified a likely optimal period for the timing of preventive intervention for infant sleep disturbance. The findings generally support Moore and Ucko's (1957) criterion by demonstrating that the most rapid progressions in this developmental task occur within the first 3 months, followed then by the next 3 months, with minimal progression from 6 to 12 months. Closer examination of the three criteria (midnight to 5:00 a.m., 8-hours, 10:00 p.m. to 6:00 a.m.) however, showed no difference in the age when infants meet either the 8-hour or Moore and Ucko's criteria. It was also established that 2 months is the most likely age at which infants will begin to sleep through the night for both the 8-hour, and Moore and Ucko's criteria. Furthermore, in the third month half of the infants have achieved this task. The developmental progression in the LUSP mirrored that for sleeping through the night, in that, during the first 3 months the most rapid developments occurred, with infants increasing their mean LUSP of 5.4 hours at 1 month to 8.4 hours at 3 months. At 6 months a bimodal distribution in SBS scores indicated a group of infants with emerging sleep disturbance and a group without. From as early as 1 month of age infants with settled sleep at 6 months had lower mean SBS scores compared with sleep-disturbed infants. Evidence of this stability in infant sleep patterns from early to later infancy was further demonstrated by the relationship of SBS scores from 2 to 12 months of age. The changes in scores over time have been affected by maturation, and for some infants more dramatically by parent initiated intervention.

10.4.1. Establishing Norms for Sleeping Through the Night

Moore and Ucko's (1957) criterion is approximated by this study, *but* there is no significant difference between Moore and Ucko's and a more meaningful 8-hour criterion. It took, however, significantly longer for infants to meet the 10:00 p.m. to 6:00 a.m. criterion, and also fewer infants met this criterion in the first year compared to the other two criteria. This difference reflects the degree of stringency of each of the criteria, specifically in the first four months. The least stringent, and which is the shortest in duration was midnight to 5:00 a.m. which demonstrated the highest rates for sleeping through at each age. The most stringent was the 10:00 p.m. to 6:00 a.m. criterion, which demonstrated the lowest rates, most likely because it determined that an infant had to sleep uninterrupted in a specified time period. However, all three of the criteria mirrored similar developmental trends in sleeping through the night.

Compared to the present study, Moore and Ucko's (1957) figures indicated a higher number of infants were sleeping through the night at each successive age. This

inflation is most likely to be an artefact of retrospective report. Moore and Ucko arrived at their findings from an estimate that was based on when the mothers first recalled their infants to have first slept through between midnight and 5:00 a.m., for four consecutive weeks. Retrospective maternal report will always be subject to inaccuracy, and will tend in the direction of enhancing the child's behaviour in socially desirable ways (Robbins, 1963). The present study corrected for this methodological problem by measuring sleeping through the night prospectively, and by providing a more accurate measure of the age at which infants first meet the criterion.

The present findings support the literature that describes developmental trends based on Moore and Ucko's (1957) findings (e.g., Blampied & France, 1993; Ferber, 1990; 1987; 1985; France et al., 1996; Richman, 1981; Wolfson, 1996). It further supports the criterion used by studies employing parental report, or direct measures, of infant sleep (e.g. Anders, 1979; Anders, 1982; Anders et al., 1983; Anders et al., 1992). It does not, however, support the rates Moore and Ucko describe at specific ages for sleeping through the night. For example, in the third month, the present study showed that half of the infants were sleeping through the night, rather than the 80% described by Moore and Ucko.

However, given the difference in method between the present study and the studies by Anders (1979), and Anders et al. (1983), the similarity in findings was unexpected. Anders and colleagues objectively recorded the infant's sleep for one night, while the present study employed parent report for six consecutive nights, and used the more stringent criterion of sleeping through of on at least 80% of occasions. Despite these differences, the present study reported almost identical figures to Anders and colleagues. It could be suggested, albeit tentatively, that there is a certain stability in sleeping through the night. In addition, further support is provided by this study for the accuracy of prospective maternal report of sleeping through the night.

10.4.2. Examining the Utility of the Moore and Ucko (1957) Criterion, the 8-Hour Criterion, and the 10:00 p.m. to 6:00 a.m. Criterion

10.4.2.1. Implications for Defining Sleeping Through the Night

This study demonstrates that the 8-hour criterion is a better criterion than Moore and Ucko's (1957) midnight to 5:00 a.m. for defining sleeping through the night. The survival analysis showed that there was no significant difference in the age when infants first begin to sleep through the night for either criterion. Thus, infants who sleep for 5 hours from midnight to 5:00 a.m. are as likely to be sleeping for 8-hours. Similarly, for both criteria at least 50% of the infants are sleeping though the night in their third month. In contrast it was not until the fifth month that half of the infants had met the 10:00 p.m. to 6:00 p.m. criterion.

These findings clearly support redefining sleeping through the night as an 8-hour criterion as it is behaviourally more meaningful and fits better with family needs and parental expectations.

10.4.2.2. Implications for the Timing of Intervention

The timing for preventive intervention was further informed by the hazard function from survival analysis. Descriptive analyses showed the rapidity of sleeping through the night for both the 8-hour criterion and the midnight to 5:00 a.m. criterion in the first 3 months. While the most rapid progression appeared to be from 1 to 2 months, a rapid progression was also evident from 2 to 3 months. Further analysis was therefore required to establish the age at which infants are most likely to begin sleeping through the night in order to better inform, and refine the timing for prevention. Consequently, the hazard function demonstrated the second month as the most likely time for the occurrence of sleeping through the night, which was then followed by the third month.

This study empirically supports observations made by Wolfson et al. (1992) and Pinilla and Birch (1993) in their preventive studies, that infants do begin to sleep through the night in the second month. Pinilla and Birch, who employed Moore and Ucko's criterion, noted a sudden increase in infants' ability to sustain longer sleep bouts when they were 6-weeks-old. Similarly, Wolfson et al. noted that when infants were 8-weeks-old they began to "spontaneously" sleep through the night. However, the studies had ceased conducting preventive intervention when the infants were 6-weeks-old, and 9-weeks-old, respectively (except for a follow-up by Wolfson et al., 1992). Findings from the present study show that preventive intervention should be continued beyond the third month when 50% of infants will be sleeping through, in order to assist the remaining 30% to sleep through earlier.

The findings of the present study would therefore suggest that the timing of Adair et al.'s (1992) and Kerr et al.'s (1996) prevention studies was not optimal. They instructed parents to begin preventive intervention when the infants were 4, and 3 months of age respectively. By these ages the majority of infants have already experienced the onset of sleeping through the night, if they are going to. This would suggest that developmentally, these studies had missed the optimum time for preventive intervention to increase the numbers of infants achieving this task. In contrast, the timing of the studies by Goodlin-Jones et al. (1997), Pinilla and Birch (1993), and Wolfson et al. (1992) was developmentally more appropriate. Parents in these three studies were instructed to implement preventive strategies prior to the age when infants begin sleeping through the night. Parents may therefore have assisted in providing appropriate cues that would have assisted infants to sleep through when

they were developmentally ready to do so. However, preventive efforts must be maintained beyond the very early months.

10.4.3. The Longest Uninterrupted Sleep Period

Data on the LUSP mirrored data on sleeping through the night and support conclusions reached in the previous section, i.e., that infants can be expected to sleep for 8 hours, their sleep time mirrors that of most adults, and that it settles most rapidly at the age of 2 months. At 1 month of age, on average, infants were reported as being capable of sleeping uninterrupted for 5.7 hours. This increased to 7.3 hours at 2 months demonstrating the largest increase over the first 12 months. By 3 months, on average, infants are sleeping uninterrupted for 8 hours. This increases gradually by 1 hour over the next 9 months.

The direction of LUSP development was generally the same as reported in other studies, however, this study reported different LUSP durations. Across the first four months, the present study reported longer durations than Parmelee et al. (1964), but shorter durations than Traisman et al. (1966) (who reported durations of 1 to 2 hrs longer at each comparable age). These differences may reflect differences in the method of the studies and may be more accurate. Parmelee et al. and Traisman et al. derived their findings from maternal recall during interviews on the infants general health. Despite that a more recent study (Jacklin et al., 1980) did not collect data until the infants were 6 months of age, the LUSP durations from 6 to 12 months were very similar to those reported in the current study.

The most rapid progression in the LUSP occurs in the first 2 months which supports other studies' investigations (Parmelee et al., 1964; Traisman et al., 1966). Wolfson et al. (1992), and Pinilla and Birch (1993) also reported increases across these ages, although these are minimal compared with the former studies. This minimal difference can be explained by Pinilla and Birch only measuring the LUSP between the hours of midnight to 5:00 a.m.

The study has shown that increases in the duration of the LUSP occur outside of Moore and Ucko's (1957) midnight to 5:00 am criterion. Parents in the present study reported that the LUSP began before midnight in the infants first and second month, starting at 10:30 p.m. and 9:50 p.m. respectively. Similarly, when infants were 6-weeks-old, Coons and Guilleminault (1984) found the longest sleep period (LSP) was predictably located between 8:00 p.m. and 8:00 a.m. Furthermore, de Roquefeuil et al. (1993) found the longest sleep span to include the period of midnight to 5:00 a.m.

Parental report of the LUSP was approximately 1 hour longer when compared with the LSP reported by Anders et al. (1983). Given that several studies have demonstrated an infants' skill in sleep self-initiation following an awakening, this was not an unexpected finding (Anders, 1979, Anders et al., 1983, Anders & Keener, 1985;

Anders et al, 1992; Minde et al., 1993). The constant difference of 1 hour requires further consideration. When comparing actigraph measures with parent report, Sadeh (1996) found parents of sleep-disturbed infants overestimated the infant's sleep percentage by 1 hour due to unreported wakefulness. Minde et al. (1993) also found from TLVR that mothers of poor and good sleepers overestimated the actual sleep time by 1 hour for both groups. Neither of these studies claimed to measure the LUSP, but they in fact did, and so were comparing actigraphic or TLVR measure of the LSP with parental report of the LUSP.

The study's findings of the LUSP provide further evidence to support, and redefine 8-hours as a criterion for sleeping through the night. Infants begin their LUSP well before midnight and are capable of sleeping for this duration by 3 months of age. The standard error of the mean indicates that infants are capable of longer durations and at earlier ages. The findings further support the rapid development in the consolidation of infants' sleep in the early months.

10.4.4. Distribution of SBS Scores

A bimodal distribution of SBS scores at 6 months of age indicated this as an age where the emergence of ISD can first be defined. Two discrete groups were identified, one group with very settled patterns of sleep, and the other without. Six months concurs with the age studies have used to first define ISD for clinical purposes (Edwards & Christophersen, 1994; France, 1989; France et al., 1996; France & Hudson, 1993; Rickert & Johnson, 1988), and with the opinion of leaders in the field who consider that infants should be sleeping through by this age (Ferber, 1996; Messer & Richards, 1993; Schmitt, 1981). The fact that some parents initiated intervention with their infants prior to 6 months provides some social validation of the expectation that infants should have settled sleep by this age.

Closer scrutiny of the sleep pattern evidenced by infants scoring greater than 7 validates its use as a cut-off score at 6 months. To achieve a score of greater than 7, an infant had to be waking at least once each night of the week, *and*, either have the total duration of the time awake exceed 30 minutes, and/or they were awakening at least twice a night. In addition, they had to evidence some other sleep disturbance (e.g. delayed duration for sleep-onset or co-sleeping). At 6 months of age 41% of the infants achieved SBS scores greater than 7, and this supports the rate reported by Scher (1991) who employed a parental definition of ISD. This provides support for the use of the SBS as a diagnostic tool for the emergence of ISD at 6 months, and also the cut-off score of above 7. No other study has employed the SBS as a measure with infants at 6 months of age.

Studies have used the SBS with samples older than 6 months, and employed lower cut-off scores than those established by the bimodal distribution in the present

study. The minimum age for the use of the SBS in studies was 8 months by France (1989), who employed a cut-off score for ISD of greater than 4. Richman (1984) employed an even lower cut-off score of 2.7, however, this was for older infants with a mean age of 20 months. Had France's cut-off score of greater than 4 been employed with 12-month-old infants in the present study, the distribution of SBS scores shows that 36% of the infants would be defined as sleep-disturbed. Furthermore, this rate is very similar to the rates reported by studies of infants the same age (Scher, 1991; Scott & Richards, 1990). This provides further support for the use of the SBS as a diagnostic tool.

This study provides evidence of a degree of stability in infant sleep patterns over the first year of life. Stability in SBS scores over time was demonstrated by the significant relationship from 2 to 12 months. This evidence would suggest that infants who demonstrate settled sleep in early infancy tend to have settled sleep in later infancy, and conversely, infants with very unsettled, or disorganised patterns of sleep in early infancy tend to have unsettled sleep throughout the first year. Given the moderate correlations, it should not be inferred that attempts by parents to intervene in their infants sleep were unsuccessful. Further research with a finer grain of analysis is needed to establish the stability, or lack of, in various sleep patterns determined by SBS scores in very early infancy and the real effect of parental intervention.

The developmental change or shift in SBS scores from 1 to 2 months also mirrors the timing of important sleep developments. That is, when infants were 2 months-old, a number of scores decreased, so they clustered between 0 - 8, representing very settled sleep. The distribution in scores at this age almost approximate a bimodal distribution, as the remaining scores clustered towards higher scores demonstrating less settled sleep. This decreasing shift in scores at 2 months coincides with the most rapid development in LUSP duration, and in sleeping through the night. This again validates the use of the SBS to quantify development.

There is no behavioural measure of early infant sleeping patterns and the need for one has been noted by experts in the field (Anders et al., 1992; Ferber, 1996; Messer & Richards, 1993; Thoman & Whitney, 1989). The SBS is an objective measure that provides a continuum of severity and could continue to be employed by normative research. The relative usefulness of the SBS as a measure of ISD has clearly been demonstrated by this study.

The SBS has not been used as a diagnostic tool with such young infants, nor as normative data, therefore certain individual components require more investigation in how they reflect various sleep patterns. First, if an infant is placed asleep into the cot at initial sleep-onset, a minimum score is achieved. In the case of ISD, this is a management technique parents employ to avoid bedtime struggles. Scoring of this item does not discriminate whether or not it is a management technique for an infant

who is difficult to settle, or not. Second, is that the scoring of certain items does not reflect settled patterns of sleep. By placing an infant into cot later at night, e.g., between 9:00 p.m. and 10:30 p.m., and they slept uninterrupted for 8 to 9 hours would result in maximum scores for two items (average bedtime and average total time slept at night in hours).

This study has shown very young infants will achieve high SBS scores because of physiological requirements and therefore a decrease in SBS scores better reflects changes that are driven by the parents responding to their infant's maturation. The mean decrease in SBS scores over the first few months are largely accounted for by the first three items because (i) the younger the infant the later they are placed into the cot at night; (ii) very young infants have a physiological requirement for night feedings, and may awaken frequently in order to meet this need, and (iii) durations for feeding young infants is on average 20 minutes (Moore & Ucko, 1957), and may be extended to deal with other health and safety needs of the infant (i.e. nappy change and winding).

Parent-initiated interventions are common (France, 1989), and are part of the natural history of infant's sleep pattern development. One adventitious set of findings in the present study was that 35% of parents deliberately intervened in an attempt to manage what they perceived to be a disturbed pattern of infant sleep. This study did not plan to collect data on parent interventions, but they became obvious as the data were collected. Consequently, it was considered necessary to establish how parental intervention might have affected the infants sleep patterns by analysing the SBS scores, and then comparing these with the scores of infant's whose parents did not intervene. Parents were generally successful in improving their infant's sleep patterns, both prior to, and when infants were 6 months or older. The mean SBS scores decreased so they were closer to the scores of infants whose parents did not intervene. The most common management technique parents reported to employ was systematic ignoring or modifications of it, such as controlled cry. (see Appendix J)

Within the first few months of life around 15% of parents considered the infant's sleep to be sufficiently disruptive as to warrant intervention. The efficacy of these interventions indicate that infant sleep behaviour may be usefully modified from an early age. On the other hand, unsuccessful parental interventions provide further support for preventive efforts, particularly in light of the negative effects of unsuccessful attempts at management (see France et al., 1996).

The present study generally supports the age-related developments predicted in the developmental model of ISD (France & Blampied, 1999). However, because the models based their developmental timing on the basis of Moore and Ucko's (1957) findings, the present study augments the models through the addition of specified developments in infants' sleep-wake organisation. The additions to the timing of the

model include: at 1 month infants have established a diurnal pattern as the LUSP regularly occurs during the night; in the second month sleeping through the night is most likely to occur; and in the third month half of the infants are sleeping through the night. At 6 months the emergence of primary ISD was demonstrated by a group of infants who were demonstrating settled sleep patterns and a group who were not. An age has therefore been identified where a measure of ISD can be employed for preventive intervention.

The preliminary findings with the SBS scores, also provide support for the model's predictions regarding the stability of various sleep patterns over the first year. The stability of SBS scores provides evidence of the maintenance of either disturbed or settled sleep patterns from very early infancy. Certain developmental trends are evident when examining the continuous distributions of SBS scores across ages, from 2 months some infants who achieve higher scores in early infancy continue to achieve higher scores in later infancy, and conversely, for infants who achieve a low score.

There is some anecdotal evidence to support the model of secondary sleep disturbance. First, six parents reported initiating intervention with infants who previously had settled sleep at 6 months, but who became unsettled prior to 12 months. Second, the SBS scores of another five infants were shown to increase above a score of 8 and be maintained for at least three months.

This study does not support 9 months as an age where sleep disturbance "suddenly appears" or is more prevalent, as claimed by previous researchers (Adair et al., 1991; Moore & Ucko, 1957; Scher et al., 1995). Rather, 8 and 9 months was the most common ages at which parents initiated intervention in an attempt to manage their infants' disturbed sleep pattern. This may reflect parental expectations of infant sleep at this age more than their sleep per se, and that parents feel capable of ensuring that this is so.

In conclusion, the present study has provided an empirical, normative base upon which future preventive decisions can be made. The present study supports and extends the findings of previous research in several ways. No other study has measured the development of infant sleep patterns prospectively at each successive age over the first 12 months, and then collected follow-up at 24 months. The developmental window for the timing of preventive intervention has been established as being within the first two months, as by the end of the second month infants are physiologically and behaviourally "ready" for preventive intervention. Sleeping through the night has been conceptually and methodologically redefined as an 8-hour criterion.

Most importantly, the present study has supported and augmented France and Blampied's (1999) developmental model's age-specific trajectory of sleep pattern development. The models' predictions of the contributory parent and infant

behaviours to developmental pathways now require testing, in order for planning an empirically based preventive intervention.

CHAPTER ELEVEN

STUDY TWO: CHOOSING PREVENTIVE INTERVENTIONS FOR INFANT SLEEP DISTURBANCE

11.1. INTRODUCTION

Study One indicated that the optimal time for prevention of ISD is in the first two months of an infant's life. As early as 2 months, there is a certain stability in infant sleep patterns noticeable through until 12 months. Young infants with highly disruptive sleep tend to also have disrupted sleep in later infancy. In choosing how to intervene for prevention, therefore, it is critical that any risk factor/s targeted for alteration are supported by empirically validated theory. This would increase the chances of the intervention being efficacious. Understanding the mechanisms would allow maintenance of early effects in later infancy. In this case, infants who are assisted in the development of settled sleep in early infancy, would continue to maintain this pattern throughout infancy.

How best to intervene for preventive intervention of infant sleep disturbance remains unclear. One of the major gaps in the research base required to inform preventive intervention concerns which variables, or risk factors, should be manipulated. The isolation of risk factors that precede ISD and which are malleable is critical to the success of preventive intervention (Mrazek & Haggerty, 1994). Equally important is the identification of the factors that occur in temporal proximity with, and are predictive of ISD. As described in Chapter Three, there are multiple factors associated with ISD, and this literature has been extensively reviewed in the past (e.g., Blampied & France, 1999; France, 1989; Goodlin-Jones et al., 2000; Messer & Richards, 1993; Sadeh & Anders, 1993; Wolfson, 1996). The association between certain parent and infant behavioural factors and ISD has been clearly demonstrated by previous research (see Chapter Three).

Parents of sleep-disturbed infants employ a greater number of management techniques during the sleep-onset period, and in response to night awakenings compared with parents of non-sleep-disturbed infants. These techniques include being present at sleep-onset; placing the infant into the cot asleep; engaging in a greater number of interventions following a night awakening; and co-sleeping. Individual characteristics of infants that have an established association with ISD include: illness, colic (or excessive crying), frequent awakenings, and certain behavioural features associated with a difficult temperament. While Anders et al. (1992) found a causal relationship between placing the infant down asleep and later ISD, the direction of influence and relative causal status of the remaining factors remains unclear. What

the research has established is that the majority of these factors frequently co-occur with a disturbed pattern of sleep. Research needs to establish which factors precede, and have predictive validity for ISD.

The behaviour management literature investigating ISD has clearly demonstrated the contribution of parent behaviour in maintaining, if not causing ISD (Adams & Rickert, 1989; Durand & Mindell, 1990; France & Hudson, 1993; Lawton et al., 1991; Mindell & Durand, 1993; Piazza & Fisher, 1991; Pritchard & Appleton, 1988; Rickert & Johnson, 1988; Rolider & Van Houten, 1984; Sanders et al., 1984;). This was described in detail in Chapter Four. Critical pieces of evidence regarding the role of parent behaviours and ISD can be described using principles of operant behaviour theory. These include establishing appropriate discriminative control of sleep-onset, the effects and schedules of reinforcement, and the role and effects of extinction.

Each of these behavioural principles has clear implications for preventive intervention, but in general, they have not been explicitly acknowledged in the prevention literature. Instead, preventive studies to date vary in their assumptions about the role of risk factors that have been manipulated (Adair et al., 1992; Goodlin-Jones et al., 1997; Kerr et al., 1996; Pinilla & Birch, 1993; Wolfson et al., 1992). This is reflected in the variation in intervention techniques employed by each study, except for Adair et al. who tested Ferber's theoretical model of behavioural sleep-onset associations.

The use of operant principles by the prevention studies has been described in detail in Chapter Five. In brief, four of the five studies instructed parents in stimulus control of approximate proximal cues for sleep-onset (Adair et al., 1992; Kerr et al., 1996; Pinilla & Birch, 1993; Wolfson et al., 1992). Kerr et al. however, failed to describe what techniques parents were instructed to employ. Wolfson et al. and Pinilla and Birch, both addressed the principles of reinforcement and withdrawing reinforcement (extinction) by emphasising the need for parents to be consistent and not overly responsive in their handling of infants at sleep-onset, and following a night awaking. Parents were also instructed to provide alternative behaviours to feeding when the infant awakened. Only one study (Adair et al., 1992), measured parental adherence to the strategies that involved operant principles.

There is no simple causal explanation for ISD, nor a single model that can inform strategies for prevention. ISD is a complex phenomenon. The explanatory models for ISD (Blampied & France, 1993; France & Blampied, 1999; Messer & Richards, 1993; Sadeh & Anders, 1993) described in Chapter Seven, illustrate the multiplicity of levels of risk factors and the pathways of influence which contribute to the development of disordered sleep. One main consistent feature in each model however is the relationship between parent-infant bedtime interaction and the development of ISD. The best theoretical model currently available for guiding research in preventive

intervention, are two co-ordinated behavioural developmental models presented by France and Blampied (1999).

No study to date has, however, tested the assumptions of these models. This is despite the fact that they were originally presented in 1992 (France & Blampied, 1996). The addition of the "coercion trap" was the only difference between the models presented in 1992 and those presented in the 1999 publication. The coercion trap was, however, a key feature of the earlier behavioural model (Blampied & France, 1993).

The first of the 1999 models describes the development of sleep self-initiation skills from birth to 3 months of age. The authors argue that the acquisition of sleep self-initiation skills is determined by interactions between infant and parent factors. Individual differences in infant sleep-state organisation, and parental behaviours are described as the determinants of whether an infant develops sleep self-initiation skills. On the infant's part, disorganised sleep-state organisation, as described by the model, includes frequent night awakenings, short durations of uninterrupted sleep, less total time asleep, and a greater number of sleep-wake transitions. By engaging in overly stimulating behaviour such as rocking the infant to sleep, placing the infant to bed asleep, or being present at sleep-onset, the model describes how parents play their part (which may be a response to infant characteristics) by providing a chain of inappropriate discriminative stimuli for sleep-onset. These parental behaviours block the infant from learning self-soothing behaviours, and associating bed-related cues with sleep-onset. Consequently the infant does not learn sleep self-initiation skills.

The second model looks at the development of primary ISD between the ages of 3 and 6 months. According to this model infants who do not have sleep self-initiation skills by 3 months of age will not resume sleep following an arousal without parent supplied discriminative stimuli. That is, if a parent is required for sleep-onset to occur, then parental presence will be required again in order for the infant to resume sleep. These infants will then have developed primary ISD by 6 months of age. Consequently, this model intimates that a deficit in the skill of sleep self-initiation before 3 months has a cumulative effect, so that infants will be very likely to develop primary ISD by 6 months because they have not learned to self-initiate sleep following a night awakening.

For these models to serve as a research guide for preventive intervention their predictions need to be tested. The implications of the models as they stand are that infants will not learn the skills of sleep self-initiation in the first 3 months if parents provide inappropriate discriminative cues for sleep-onset, such as being present at sleep-onset and placing an infant into the cot asleep. These developments are also determined by the contribution of individual differences in infant sleep-state organisation that render the infant vulnerable to frequent arousals. The consequent

deficit in sleep self-initiation skills will then have a cumulative effect resulting in primary ISD by 6 months of age. So from 3 months to 6 months, if an infant has not acquired appropriate self-initiation skills, then the conditions necessary for sleep-onset will be required for resumption of sleep following a night awakening. Depending on the intensity of the parental response to awakenings infants may develop a night awakening problem.

Developmental data is required to determine whether these parent and infant behaviours precede and potentially predict pathways to both sleep-disturbed or settled sleep patterns as the models predict. It would be of both practical and theoretical interest to establish how well the two developmental models address these issues.

The aim of the second study was to test the predictions of France and Blampied's (1999) first two developmental models, specifically the key parent and infant behaviours which occur in close proximity to ISD. A discriminant functional analysis was used to predict from these variables membership in a sleep-disturbed or non-sleep-disturbed group as determined by SBS scores at 6 and 12 months. In order to address this aim the specific questions investigated in Study Two include:

1. At 1 month of age do infants later classified at 6 and 12 months as sleep-disturbed and non-sleep-disturbed score significantly differently on the:

infant variables of -

- total sleep time
- number of night awakenings
- number of sleep/wake transitions
- duration of the LUSP

and the *parent* variables of -

- number of rituals at sleep-onset
- presence at sleep-onset
- placing the infant down asleep
- interventions following a night awakening
- and co-sleeping.

2. Which of these infant factors (described above) at 1 month predict membership in a group of sleep-disturbed infants at 6 and 12 months of age?

3. Which parental behaviours at 1 month (described above) predict infant membership in a group of sleep-disturbed infants at 6 and 12 months of age?

11.2. METHOD

11.1.1. Design, Setting and Procedures

The design, setting and procedures for the study are as described in the Method section in Chapter Nine.

11.2.2. Participants

The participants were 52 infants and their parents from the original sample of 75 described in Study One. The sample of 52 was chosen because they entered the study and returned a sleep diary when the infant was 1 month of age. The remaining 22 infants and their parents did not enter the study until the infant was 2 months of age, and therefore did not provide data when the infant was 1 month of age. The demographics of this sample have already been described (see Table 12).

11.3. MEASURES

11.3.1. Dependent Variables

1. The first dependent variable was whether an infant was in an emerging sleep-disturbed (SD) group or not (NSD), as defined at 6 months of age. In order for an infant to be defined as NSD, she/he had to achieve a SBS score of 7 or less, at 6 months of age. In order for an infant to be defined as SD she/he had to achieve a SBS score of 8 or more, at 6 months of age.
2. The second dependent variable was whether an infant was in either a NSD group or a SD group at 12 months of age. In order for an infant to be classified as NSD, she/he had to achieve a SBS score of 5 or less, at 12 months of age. In order for an infant to be classified as SD, he or she had to achieve a SBS score of 6 or more, at 12 months of age.

The basis for assignment of the participants at 6 months to either a SD or a NSD group was established in Study One, Chapter 10. The bimodal distribution evident at 6 months was separated by the score of 8 which was scored by only two infants. Also at this age the cut-off score has considerable validity. In order to achieve a score of greater than 7 an infant had to be waking at least once each night of the week, *and* either the total duration of the time awake exceeded 30 minutes, or awakening at least twice a night. In addition, he or she had to evidence some other sleep disturbance (e.g., delayed duration for sleep-onset, extended duration during a night awakening, co-sleeping). Of the sample of 52 infants at 6 months, 23 (44%) achieved an SBS score greater than 7, while 29 (56%) achieved a score below 8. Only one previous study has

provided rates of ISD at 6 months (Scher, 1991). The rate of 44% is comparable to Scher's who employed a parental definition of ISD.

In order for an infant to be assigned to a SD group at 12 months he or she had to achieve a SBS score greater than 5. Of the 52 infants, 15 (29%) who comprised the SD group at 12 months, 14 infants had been in the SD group at 6 months (primary sleep disturbance), and, one infant shifted from the NSD at 6 months into the SD group at 12 months (secondary sleep disturbance). The remaining 37 (71%) achieved scores of 5 or less to comprise the NSD group at 12 months. Of this group, 9 infants had formerly been in the SD group at 6 months, but their scores decreased in the intervening months to be included in the NSD group at 12 months. Of these 9 infants, one infant's parents had initiated intervention resulting in the infant achieving a score below 6.

The rate of 29% fits within range of ISD cited by previous studies for infants at a similar age (e.g., Acebo et al., 1995; Adair & Bauchner, 1993; France, 1989; Lee, 1992; Mindell, 1993; Reid et al., 1999; Scott & Richards, 1990; Stores, 1996; Van Tassel, 1985; Walters, 1993). However, it is slightly lower than the two studies that reported rates at 12 months (Scher, 1991; Scott & Richards, 1990).

As described earlier studies have used various cut-off points to define ISD. Richman (1985) stated a score between 8 and 11.9 reflects "moderate" sleep disturbance, and a score of 12 indicates a "severe" sleep disorder. This score of 5 or less was chosen as a cut-off to determine group membership in the older group because: (i) it was the mean SBS score established in Study One at 12 months (ii) a score of 4.9 and lower defines a "good" sleeper aged between 12 and 36 months (Minde et al., 1993), and (iii) because it was 1 score above France's (1989) cut-off for clinical ISD and so provides a conservative measure. France used infants with a similar mean age as those in the present study. France justified the cut-off score of above 4:

... because it gave a reasonable margin above Richman et al.'s (1985) criterion of 2.8 as being an average SBS score for children who are sleeping well. In order to achieve a score of 4 on the SBS the infant had to be awakening more than once or twice a week and also would have to have some other sleep disturbance. (p. 250)

11.3.2. Independent Variables

Independent variables are referred to as "predictor" or "discriminating variables" and were derived from the daily sleep diaries completed by parents. Definitions of these variables have been presented in the Method section (Chapter Nine). The majority of these variables are based on the predictive influence of the major proximal parent (presence at sleep-onset, placing infant down asleep) and infant behaviours (sleep-state organisation) in France and Blampied's (1999) first and second

developmental models. They are listed below and have been sorted according to whether each was an infant variable or a parent variable.

11.3.2.1. Infant Variables

The means were derived from each separate diary for each age over the 12 months. The means were derived by establishing the total number of event occurrences as recorded by the parents, divided by the number of nights for which the diary was completed. Six nights was the modal number of nights for which diaries were completed.

1. LUSP:

The weekly mean LUSP was reported in minutes.

2. Night awakening:

The mean number of night awakenings for the week was reported.

3. Total Sleep Time:

The weekly mean TST was reported in minutes.

4. Number of Sleep/Wake transitions:

A mean number of sleep-wake transitions for the week was reported.

11.3.2.2. Parent Variables

1. Parental presence at sleep-onset

2. Placing a sleeping infant into the cot at initial sleep-onset:

These two variables were divided into three categories in order to simplify the data. The categories differentiated infants whose parents reported engaging in either of these behaviours: (i) on the majority of occasions, (defined as 80% or more); (ii) frequently, (defined as 50% - 79% of occasions); or (iii) on few occasions, (defined as occurring for less than 50% of the nights that parents completed the diaries).

3. Number of parent rituals:

The weekly mean number of the rituals parents engaged in prior to sleep-onset was reported.

4. Number of parent interventions following a night awakening:

The mean number of parent interventions following each night awakening was reported.

5. Co-Sleeping:

From each diary co-sleeping was scored dichotomously, recorded as either, (i) "yes" if the infant was brought into the parental bed following a night awakening on more than one occasion for that diary, and for a total duration of longer than 6 hours (this criterion was chosen because it was the minimum criterion for co-sleeping on the SBS), or (ii) "no" if they did not.

11.4. PROCEDURE FOR DATA ANALYSIS

11.4.1. Comparative Analyses

The study first sought to establish if there were any significant differences between scores on the independent variables at 1 month of age for the SD and the NSD groups at 6 and 12 months of age. The categorical variables of parental presence at sleep-onset, placed into the cot asleep, and co-sleeping were analysed using Pearson's chi-square. The continuous variables of mean LUSP, mean number of night awakenings, mean number of parental interventions following a night awakening, mean number of sleep rituals during sleep-onset, mean number of sleep/wake transitions, and mean total sleep time were analysed with two tailed t tests for independent means. All analyses were conducted using the software packages STATISTICA (Statsoft, 1984), and SPSS (SPSS inc., 1999).

11.4.2. Discriminant Function Analysis

Categorical and continuous data were entered in to STATISTICA for discriminant function analyses to be performed. Variables of *parental presence*, and *placed down asleep* were assigned numerical codes according to the proportion of time that events occurred. Data was coded "3" when there was an 80% occurrence of the variable, "2" if the occurrence was between 50% and 79%, and "1" if the occurrence was between 0% and 49% (e.g., if a parent was present at sleep-onset for 83% of occasions, a coding of 3 was given). The dichotomous variable of *co-sleeping*, was coded as "1" if an event did not occur, and "2" if the event did occur. For example, if an infant was co-sleeping the variable was coded as 2, whereas if an infant remained in his/her own bed it was coded as 1. Continuous data were entered as means.

Direct discriminant function analyses were conducted. Using this type of discriminant function analysis all of the variables are entered simultaneously into the

analysis. A linear combination of the independent variables is formed and serves as the basis for assigning cases to groups.

The results that report the outcome of discriminant function analysis include: (i) the eigen value, which is the ratio of the between-groups to within-groups sum of squares, (a large value is associated with good discriminant function); (ii) the canonical correlation which is a measure of the degree of association between the discriminant scores and the groups. This was calculated using a Pearson's correlation coefficient. The proportion of variance was calculated as 1 minus the Wilks' lambda, which provides a test of the null hypothesis that the population means are equal. Small differences do not permit good discrimination among groups.

11.5. RESULTS

The analyses are divided into two sections. In the first section, the SD group and the NSD group at 6 months are compared on each of the independent variables measured at 1 month of age. The results of a discriminant function analysis are then described. This examined the ability of the independent variables at 1 month to predict group membership at 6 months of age.

In the second section, the SD group and a NSD group defined at 12 months of age are compared on each of the independent variables at 1 month of age. The results of a discriminant function analysis are then described. This examined the ability of the independent variables at 1 month of age to predict group membership at 12 months of age.

11.5.1. Section I: 6 Month Data

11.5.1.1. T-test Results for 1 Month Continuous Predictor Variables for the NSD and SD Groups:

Table 19.

Means and standard deviations of predictor variables at 1 month for the NSD and SD groups.

	Group Membership			
	NSD ¹		SD ²	
	Mean	(sd)	Mean	(sd)
<i>Infant Variables</i>				
LUSP (minutes)*	353.2	(94.5)	293.2	(89.2)
Night Awakening***	6.1	(2.8)	10.3	(4.5)
Total sleep time (minutes)*	878.6	(133.6)	801.4	(112.6)
Sleep/wake transitions	5.2	(1.5)	6.1	(1.6)
<i>Parent Variables</i>				
Sleep rituals at onset	4.0	(1.2)	4.4	(1.4)
Parental interventions*	2.5	(1.1)	3.2	(1.5)

Note. ¹N=29 ²N=23

*p<.05

***p<.001

11.5.1.2. Chi Square Results for 1 Month Categorical Predictor Variables for the NSD and SD Groups

Table 20.
Parental presence.

% of occasions parent present	Group membership at 6 months	
	NSD	SD
	n	n
80%	2	14
50 - 79%	8	6
< 50%	19	3

($\chi^2(2) = 20.5, p < .001$)

Table 21.
Put down asleep.

% of occasions placed into bed asleep	Group membership at 6 months	
	NSD	SD
	n	n
80%	3	12
50 - 79%	7	4
< 50%	19	7

($\chi^2(2) = 11.21, p < .001$)

Table 22.
Co-sleeping.

Co-sleeping	Group membership at 6 months	
	NSD	SD
	n	n
Yes	2	11
No	27	12

($\chi^2(1) = 11.46, p < .001$)

At 1 month of age, infants defined as SD at 6 months have more unsettled sleep patterns and more parental interventions following a night awakening compared with infants defined as NSD. Table 19 shows that the means for the SD group are significantly higher for the three infant variables of total sleep time ($p < .05$), night awakening ($p < .001$) and sleep/wake transitions ($p < .05$) than the NSD group. In addition, the LUSP was significantly shorter in duration for the children in the SD group ($p < .05$). Parents of infants in the SD group engaged in a significantly higher number of parental interventions following a night awakening than parents of infants in the NSD group ($p < .05$). Only the number of sleep rituals prior to sleep-onset was not significant.

As shown in Tables 20-22, compared with parents of infants in the NSD group, parents of infants in the SD group were more likely to put their infants into the cot asleep ($p < .001$), be present at sleep-onset ($p < .001$), and co-sleep ($p < .001$) at 1 month of age.

11.5.1.3. Prediction of Group Membership at 6 Months

A direct discriminant function analysis was performed to test the relative predictive power of the 9 variables for membership in either a SD or a NSD group at 6 months of age. The variables entered into the analysis were mean total sleep time, mean number of night awakenings, mean number of sleep/wake transitions, mean LUSP, mean number of parental interventions, mean number of sleep rituals, percentage of occasions with parental presence at initial sleep-onset, percentage of occasions a sleeping infant was placed into the cot at initial sleep-onset, and whether the infant co-slept.

Table 23.

Canonical discriminant functions for SD/NSD group membership.

Canonical Correlation	Wilks' Lambda	Chi-Square	df	Sig.
.78*	.39	41.9	9	.000

Note. *60% of the variance explained

The results of this analysis were significant. As shown in Table 23 Wilks' lambda was .39, $(9, 51) = 41.85$, $p < .0001$ which demonstrates a high discriminating power, or a "good" discriminant function making it unlikely that infants in the SD group and those in the NSD group had the same means at 1 month on the discriminant function. The large eigenvalue of 1.5 also indicates a "good" discriminant function.

The canonical correlation discriminant function indicated that a relatively large amount (60%) of the variance in predicting membership to a sleep-disturbed group at 6 months was accounted for when all the variables were combined.

Table 24.
Standardised Canonical Discriminant Function coefficients of 1 month
predictor variables.

Predictor variable	Canonical coefficient
% Nights of parental presence	-.52
% Placed down asleep	-.19
Co-sleeping	.51
Night awakenings	.58
Total sleep time	-.44
Longest uninterrupted sleep period	.24
Sleep/wake transitions	.21
Sleep-onset rituals	-.10
Parental interventions	-.01

The standardised discriminant functions for the sample as seen in Table 24 differentiates, or discriminates between the SD and NSD groups in terms of three variables that have loadings in excess of .50, the number of night awakenings, (.58), parental presence at sleep-onset, (-.52), and co-sleeping (.51). That is, at 1 month infants in the SD group had a greater number of night awakenings (mean = 10.35) than infants in the NSD group (mean = 6.14). Infants in the SD group were more likely to co-sleep following a night awakening ($\chi^2(1) = 11.46, p < .001$), and to have had a parent present at sleep-onset ($\chi^2(2) = 20.5, p < .001$). The number of night awakenings (with a loading close to .6) appears to be the variable which demonstrates the strongest association with group membership.

Table 25.
Classification matrix for group membership

		Outcome	
Prediction	Actual Group	No. of cases	Predicted Group Membership
			NSD SD
	NSD	29	27 (93.1%) 2 (6.9%)
	SD	23	3 (13.0%) 20 (87.0%)

Percent of original grouped cases correctly classified: 90.4%

The analysis produced accurate classification in 90.4% of cases (47 out of 52). As shown in Table 25, 27 cases (93.1%) were predicted correctly to be members of the NSD group, while 2 (6.9%) were assigned incorrectly to the SD Group. Similarly, 20 (87%) of the SD group cases were identified correctly, and 3 (13%) were misclassified. The 90.4% classification accuracy is high when compared to the 50% *a priori* chance of classifying correctly based on chance alone.

11.5.2. Section II: 12 Month Data

11.5.2.1. T-test Results for 1 Month Continuous Predictor Variables for the NSD and SD Group at 12 Months

Table 26.
Means and standard deviations of predictor variables at 1 month for the NSD and SD groups.

	Group Membership			
	NSD ¹		SD ²	
<i>Infant Variables</i>	Mean	(sd)	Mean	(sd)
LUSP (minutes)*	343.4	(98.00)	285.4	(79.9)
Night awakenings***	6.8	(3.5)	10.9	(4.4)
Total sleep time (minutes)	854.7	(123.1)	819.1	(145.4)
Sleep /wake transitions	5.4	(1.6)	6.1	(1.6)
<i>Parent Variables</i>				
Sleep rituals at onset	3.9	(1.3)	4.6	(1.5)
Parental interventions*	2.6	(1.3)	3.3	(1.3)

Note: ¹(n=37) ²(n=15)

*p<.05

***p<.001

At 1 month of age, infants defined as SD at 12 months have a greater number of awakenings and shorter LUSPs than the NSD group. This can be seen in Table 26, where the mean for the 1 month variable of number of night awakenings is significantly higher for the SD group than for the NSD group ($p<.001$). Furthermore, the mean for the variable LUSP shows a significantly shorter duration for the SD group than for the NSD group ($p<.05$). Of the parent variables, parents of SD infants engaged in a significantly greater number of interventions following a night awakening compared with parents of NSD infants.

11.5.2.2. Chi Square Results for 1 Month Categorical Predictor Variables for the NSD and SD Groups

Table 27.
Parental presence.

% of occasions parent present	Group membership at 12 months	
	NSD	SD
	n	n
80%	5	11
50 - 79%	12	3
< 50%	20	1

($\chi^2(2) = 18.91, p < .001$)

Table 28.
Put down asleep.

% of occasions placed into bed asleep	Group membership at 12 months	
	NSD	SD
	n	n
80%	6	9
50 - 79%	10	1
< 50%	21	5

($\chi^2(2) = 10.35, p < .01$)

Table 29.
Co-sleeping.

	Group membership at 12 months	
	NSD	SD
Co-sleeping	n	n
Yes	7	6
No	30	9

($\chi^2(1) = 2.53, n.s$)

At 1 month of age parents of infants in the NSD group were significantly more likely than parents of infants defined as SD at 12 months to put their infants into the

cot asleep and to be present at sleep-onset. There was no difference between the groups for co-sleeping.

11.5.2.3. Prediction of Group Membership

A direct discriminant function analysis was performed to test the relative predictive value of the 9 variables in either a SD or a NSD group at 12 months of age. Variables entered into the analysis were: mean total sleep time, mean number of night awakenings, mean number of sleep/wake transitions, mean LUSP, mean number of parental interventions, mean number of sleep rituals, percentage of occasions with parental present at initial sleep-onset, percentage of occasions a sleeping infant was placed into the cot at initial sleep-onset, and whether the infant co-slept.

Table 30.
Canonical Discriminant Functions for group membership.

Canonical Correlation	Wilks' Lambda	Chi-Square	df	Sig.
.64*	.34	23.6	9	.005

*36% of the variance explained

Table 30 shows the results of this analysis were significant, the Wilks' lambda was .34, (9, 51) = 23.6, $p < .01$, which demonstrates a high discriminating power, or a "good" discriminant function. Thus, it appears unlikely that infants in the SD group and those in the NSD group have the same means on the discriminant function. The large eigenvalue of .68 also indicates "good" discriminant function.

The canonical correlation discriminant function indicates that 36%, of the variance in predicting membership to a sleep-disturbed group at 12 months was accounted for by the 1 month measures.

The standardised discriminant functions for the sample shown in Table 31 differentiates, or discriminates between the SD and NSD groups in terms of two variables that have loadings in excess of .50, parental presence at initial sleep-onset, (.73) and the number of night awakenings, (-.53). That is, infants in the SD group have a greater number of night awakenings (mean = 10.9) compared to the NSD group (mean = 6.8). Infants in the SD group also experience shorter durations of the LUSP (mean = 285.4) than infants in the NSD group (mean = 343.4). The variable of parental presence at initial sleep-onset with a loading of .73 demonstrates the strongest association with group membership.

Table 31.
Standardised Canonical Discriminant Function coefficients of 1 month
predictor variables.

Predictor variable	Canonical coefficient
% Nights of parental presence	.73
% Placed down asleep	.09
Co-sleeping	-.05
Night awakenings	-.53
Total sleep time	.19
Longest uninterrupted sleep period	-.23
Sleep/wake transitions	.06
Sleep-onset rituals	-.18
Parental interventions	-.05

Table 32.
Classification matrix for group membership.

		Outcome	
Prediction	Actual Group	No. of cases	Predicted Group
			Membership
			NSD SD
	NSD	37	32 (86.5%)
	SD	15	2 (13.3%)
			3 (13.5%)
			13 (86.7%)

Percent of original grouped cases correctly classified: 86.5%

The analysis produced accurate classifications in 86.5% of cases (45 out of 52). As shown in Table 32, 32 cases (86.5%) were predicted correctly to be members of the NSD group, while 5 (13.5%) were assigned incorrectly to the SD Group. Similarly, 13 (86.7%) of the SD group cases were identified correctly, and 2 (13.3%) were misclassified. The 86.5% classification accuracy is high when compared to the 50% *a priori* chance of classifying correctly based on chance alone.

11.6. DISCUSSION

This study has demonstrated certain parent and infant behaviours to antedate and predict the emergence of ISD at 6 months, and antedate and predict ISD at 12 months of age. As early as 1 month of age, infants in the emerging SD group at 6 months sleep less over 24 hours, awaken more frequently, have a greater number of sleep/wake transitions, and shorter LUSP durations than NSD infants. During the sleep-onset period, parents of 1-month-old infants in the SD group at 6 months engaged in a greater number of sleep rituals, were present when the infant fell asleep, placed the infant into the cot already asleep, during a night awaking engaged in a greater number of interventions, and co-slept compared to the parents of NSD infants. Infants in the SD group at 12 months, had shorter LUSPs and a greater number of night awakenings than infants in the NSD group. The parents of SD infants at 12 months, were more likely to be present at sleep-onset, co-sleep, and engage in a greater number of parental interventions than parents of NSD infants.

Three variables measured as early as 1 month predicted group membership in 90.4% of the infants to either an emerging SD group, or a NSD group, at 6 months. At 1 month, one infant sleep-state organisation characteristic (frequent night awakenings) and two parent behaviours (presence at sleep-onset, and co-sleeping) predicted membership to a sleep-disturbed group at 6 months. At 1 month of age, the variables of infant sleep-state organisation (i.e. frequent night awakenings) and one parent behaviour (presence at sleep-onset), were found to successfully predict group membership at 12 months in 86.5% of the infants.

11.6.1. Comparative Analyses of Predictor Variables

Four infant variables (total sleep time, night awakenings, sleep/wake transitions, LUSP) and five parent variables (parental interventions, presence at sleep-onset, placed down asleep, co-sleeping) were significantly different at 1 month for both the SD and NSD groups at 6 months. This represents eight of the nine variables studied. The only variable without significant difference was the number of sleep rituals at sleep-onset. Two infant variables (LUSP, night awakenings) and three parent variables (parental interventions, presence at sleep-onset, and co-sleeping) were significantly different at 1 month for both the SD and NSD groups at 12 months. Four variables without significant difference included total sleep time, sleep/wake transitions, sleep rituals at sleep-onset, and placed down asleep.

11.6.1.1. Infant Variables

Clearly then, infants in the SD groups at 6 and 12 months have more disorganised sleep-wake patterns in the first month of life. At 1 month, the nocturnal

sleep patterns of SD infants at 6 months are characterised by short durations of sleep that are punctuated by frequent arousals accompanied by night awakening. Over the 24 hour period, they will experience less total sleep, and have a greater number of sleep/wake transitions. Infants defined as having SD at 12 months experience shorter LUSPs and awaken more frequently at night compared to NSD infants. Therefore, an implication for prevention may be to target these infants with highly disorganised sleep in very early infancy.

These results are consistent with other studies reporting an association between disrupted sleep patterns in early infancy and ISD in later infancy (Bernal, 1973; Weissbluth et al., 1984; Zuckerman et al., 1987) but none of the studies have measured this variable early enough to establish its predictive value. Weissbluth et al. found from retrospective maternal report that infants defined as "night wakers" between the ages of 4 and 8 months awakened more and slept less in early infancy than "non-wakers". In a sample of older infants, Zuckerman et al. found frequent night awakenings at 8 months were associated with ISD at 3 years of age. Bernal implied a relationship between frequent awakenings as a new-born with ISD at 12 months, however, no statistical analyses were provided to support this claim.

11.6.1.2. Parent Variables

At 1 month of age, parents of sleep-disturbed infants at 6 and 12 months employed different strategies to manage infant sleep-onset and night awakenings, compared with the parents of non-sleep-disturbed infants. These findings further support an association between parental handling and ISD (Adair et al., 1991; Adair et al., 1992; Anders et al., 1992; Blampied & France, 1993; France & Blampied, 1999; France & Hudson, 1990). Comparison with other studies is difficult, as other than Anders et al. no further studies have investigated an association with parent handling factors and ISD at 1 month of age.

In this, as in other studies, inappropriate cues for sleep-onset association were found to be associated with ISD. Four months was the earliest age that parental presence at sleep-onset has been associated with ISD (Scher et al., 1995). However, their data were aggregated to include infants up to 48 months of age. The next earliest reported age is 9 months (Adair et al., 1991; Adair et al., 1992), followed then by 12 months or older (Crowell et al., 1987; Johnson, 1991; Van Tassel, 1985).

The association between placing an infant into the cot already asleep and ISD was established at the earlier age of 3 weeks by Anders et al. (1992). Keener et al. (1988) reported this association at 6 months, while Scher et al. (1995), reported this for 4 to 48 months of age. As regards specific parental behaviour during sleep-onset, Crowell et al. (1987) found that parents of infants with ISD held their child during sleep-onset.

Co-sleeping following a night awakening at 1 month was found in the current study to be associated with ISD at 6 months. Several studies have also reported this association (Crowell et al., 1987; Kataria et al., 1987; Johnson, 1991; Lozoff et al., 1985; Van Tassel 1985; Wolke et al., 1995a; 1995b) but only as early as 4 months (Van Tassel 1985). The remaining studies established this association with infants from 12 months or older. Wolke et al. (1994) claimed an association between co-sleeping at five months and ISD. However, their results show that disturbed sleep patterns at 5 months were predictive of co-sleeping at 56 months of age. Not, co-sleeping at 5 months being not associated with later ISD.

Consistent with other studies (Anders et al., 1992; Johnson, 1991; Minde, et al., 1993; Van Tassel, 1985) parents of sleep-disturbed infants also engaged in a greater number of interventions following an awakening.

11.6.2. Predictors of Group Membership at 6 and 12 Months of Age

The current study has also shown a number of factors at 1 month to precede ISD at 6 and 12 months. The infant factors (disorganised sleep-wake patterns characterised by frequent awakenings), and parent behaviours which are overly stimulating and provide inappropriate cues for sleep-onset (i.e. parental presence at sleep-onset, placing an infant in the cot asleep) have been described in the developmental models as likely to have a causal role in the development of ISD (France & Blampied, 1999). It is of theoretical and practical interest then to establish which of the variables or combination of variables are predictive of membership to either a SD or a NSD group at 6 and 12 months. No other study prior to this has done so.

At 1 month of age, the combination of night awakenings, parental presence, and co-sleeping demonstrated a strong association with membership in an emerging SD group at 6 months of age. At 1 month of age night awakenings and parental presence demonstrated a strong association with group membership in the SD group at 12 months of age. Frequent night awakenings is an aspect of infant sleep-state organisation. As such it is reflective of an infant's physiological characteristics creating vulnerability to later ISD as predicted by the model. Significant findings between presence at sleep-onset and co-sleeping and ISD confirm the contributory role that parent behaviours play in the development of ISD. Historically, the role of parental behaviours had been described as maintaining, rather than causing ISD.

These findings at one month show that clearly there is an interaction effect between: (i) the infant's sleep-state organisation (frequent night awakenings) which may "drive" the parental presence at initial sleep-onset, and/or to co-sleep: and (ii) the parent behaviours, that may also "drive" the maturation of infant sleep-state organisation, and thus instigate the development of ISD. Parent behaviours that are

over-stimulating, or interruptive of sleep process may influence the length of infant sleep and therefore the frequency of night awakenings. On the other hand, infants with less organised states may exacerbate characteristics of the parents which would contribute further to parents being over-stimulating. Because this synergistic relationship has here been established as early as 1 month of age, then the frequent awakening and the parent behaviour need to be targeted together for prevention. This in turn would may make parents less anxious, particularly in response to infants more "at risk" due to their physiological disposition. These issues are addressed in more detail in the next chapter.

Causal explanations of the role the three predictor variables play in contributing to the development of ISD, as suggested by the developmental models (France & Blampied, 1999) are described below.

11.6.2.1. Frequent Night Awakening

The discriminant function analysis established frequent night awakening at 1 month of age, as having the strongest association for the prediction of membership to a group with emerging sleep disturbance at 6 months. Frequent night awakenings also predicted group membership for SD at 12 months. In the early neonatal period, night awakenings can be considered as an "infant driven" behaviour, as awakenings are influenced by maturation of the neurological processes underlying sleep-state organisation (France & Blampied, 1999), and reflect the developing ability of infants to regulate their own cycles (Emde & Robinson, 1979). Frequent night awakening at 1 month is indicative of more "disorganised" sleep-wake state organisation.

"Disorganised" infants experience shorter REM/NREM cycles and hence more frequent complete arousals. Consequently, the infant has a greater vulnerability to waking more regularly (France & Blampied, 1999). Consistent with this, Papousek and Papousek (1996) noted that clinically referred infants between the ages of 1 and 6 months with very disrupted sleep patterns showed immature sleep-wake organisation. Similarly, Bamford et al. (1990) found that 6-week-old infants who awakened frequently and had short episodes of sleep in early infancy, remained wakeful throughout the first year. Furthermore, Jacklin et al. (1980) reported that from 6 to 33 months the longest period of sleep was a stable individual characteristic over time. Thus infants with disorganised sleep-state organisation in early infancy are at risk of maintaining this pattern of disrupted sleep.

There are no other studies in the literature on infant sleep that have employed discriminant function analysis that can be used for comparison with the current study. These findings, do support the assumption in France and Blampied's (1999) first model. That is that infants do contribute to their own sleep disturbance through the quality of their sleep-state organisation characterised by their frequent night

awakenings. Clearly, infants with disorganised sleep-state organisation need to be targeted for preventive intervention so parents responses are appropriate and serve to assist these infants in becoming "more organised". These infants may could also be defined as a special population who present a greater "risk" of developing ISD. These implications are described in greater detail in Chapter 12.

11.6.2.2. Parental Presence at Initial Sleep-Onset

At 1 month of age, parental presence at sleep-onset demonstrated the strongest association with prediction of group membership to a SD group at 12 months of age. It also predicted group membership at 6 months. No other study has established parental presence as predictive of later ISD at such an early age.

Parental presence at sleep-onset is a proximal cue for sleep-onset that potentially blocks the establishment of sleep self-initiation (Blampied & France, 1993; France & Blampied, 1999). The underlying causal mechanisms of how this occurs have been described in detail in France and Blampied's developmental model. These authors drew on their earlier behavioural model (Blampied & France, 1993) and employed principles of operant behaviour theory to clarify the role of parental presence in the development of ISD. In brief, clear stimulus control over the elements in the going-to-bed-falling-asleep behaviour chain is necessary for the development of appropriate sleep patterns (Blampied & France, 1993; Bootzin, 1977; France & Blampied, 1999; Sanders et al., 1984). Parents provide inappropriate external cues for sleep-onset by being present and therefore block the infant from developing appropriate stimulus control of sleep-onset through bed-related cues, and also from self-produced comfort cues. When left unattended at sleep-onset the infant will evidence some distress, and signal. If a parent then attends and remains with the infant until sleep occurs, the infant establishes inappropriate parent-related cues rather than bed-related cues for sleep-onset (France & Blampied, 1999).

Blampied and France (1993) describe how a behaviour trap is created as a consequence of inappropriate sleep-onset cues that assist in the development of ISD. Following a night awakening, infants' resumption of sleep will occur if the setting events for sleep-onset are present (Blampied & France, 1993; Ferber, 1985). If the infant has only been exposed to the inappropriate cues for sleep-onset of parental presence these parent-associated cues will be required for resumption of sleep.

Blampied and France (1993) described how a behaviour trap is created as a consequence of inappropriate sleep-onset cues that assist in the development of ISD. Because sleep-onset is associated (and dependent on) parental presence, then these setting events will be required for sleep self-initiation following night awakenings. Parental attendance to an infant signalling at sleep-onset, or at night awakenings will have consequences if it is sufficiently reinforcing. That is, the infant will be positively

reinforced by having the parents attend, while the parents will be negatively reinforced by the termination of the infant's crying (Blampied & France, 1993). These competing parent and infant behaviours are under powerful double reinforcement contingencies which can create a behaviour trap, specifically a "coercion trap" (Patterson, 1982, in Blampied & France, 1993). The sleep disturbance is maintained as parents and child act to avoid aversive circumstances stemming from leaving the infant to fall asleep alone (Blampied & France, 1993). This reinforcement contingency will assist the infant and parents to learn to anticipate each other's behaviour, so the infant's crying will become increasingly intense, and the parental behaviours will become more immediate and possibly involve a greater number of individual behaviours (France & Blampied, 1999).

Certain parental characteristics have been proposed to result in parental behaviours that contribute to the development of ISD (France & Blampied, 1999). These authors suggested that when parents engage in stimulating behaviours during sleep-onset it can be the result of stress and self-doubt, that is often associated with negative affect and insecure parental attachment. These parents are more likely to be present at bedtime because they have difficulty separating from their infants (Adair et al., 1991, 1992). Furthermore, infants with disorganised sleep-state organisation are more likely to exacerbate the parents' stress and self doubt because of the highly disrupted sleep patterns, and because they are more likely to have problems with their efforts at self-regulation and self-soothing.

11.6.2.3. Co-Sleeping

The parent behaviour of bringing the infant into the parental bed (co-sleeping) successfully predicted group membership for the emerging SD group at 6 months, but not at 12 months. No other studies reported this as a predictor of ISD as early as 1 month of age. Using a hierarchical multiple regression analysis, Van Tassel (1985) found that co-sleeping was a predictor of sleep disturbance in both early and later infancy. Elias et al. (1986), also using regression analysis found that co-sleeping at 2 weeks was a significant predictor of sleep-bout length at 24 months. They did not, however, define ISD.

The hypothetical causal link between co-sleeping and ISD can be described in operant terms (France & Blampied, 1999). By using co-sleeping as a management strategy for night awakening a powerful double reinforcement contingency is operating which will continue to shape and maintain co-sleeping. Any attempts by parents to withdraw the reinforcement associated with co-sleeping, such as leaving the infant alone, will most likely result in an aversive PERB, whereby the infant's crying is more intense and lasts for long durations. Parents will be more likely to engage in avoidance behaviours, such as co-sleeping, which will consequently strengthen the coercion trap

(France & Blampied, 1999), as the infant resumes sleep and parents do not have to experience the infant's distress.

Explanation for why co-sleeping at 1 month is predictive of ISD at 6 months, but not at 12 months, can be seen in the change in group composition (SD versus NSD) over the 6 month period. The sleep patterns of 9 children who were in the SD group at 6 months, became more settled so that they entered the NSD group at 12 months. Conversely, one infant had moved from the NSD group at 6 months to the SD group at 12 months.

In conclusion, this study has assisted in addressing one of the major gaps in the knowledge base. It has identified a number of variables that precede ISD, and of these, three variables accurately predict of membership to either a SD or NSD at 6 and 12 months of age. Critical to these findings was the establishment of one infant variable and two parent behaviours that at 1 month were predictive of SD at 6 and 12 months. The study has supported and augmented certain predictions about the relationship between infant and parent behaviours in the development of settled and disturbed sleep, as set out in France and Blampied's (1999) first two developmental models. The longitudinal nature of the study has helped clarify the role of infant sleep-state organisation and parental behaviours in the development of infant sleep patterns. That is, the combination of frequent night awakenings together with parental presence and co-sleeping predict group membership to either a sleep-disturbed group or a non-sleep-disturbed group at 6 months of age, while the first two behaviours remained predictors at 12 months. One month is shown to be the earliest age at which these factors can be first predicted.

These three factors are transactional and systemic, and are inextricably linked and should all be targeted as candidates for the purpose of preventive intervention. The parent behaviours that provide inappropriate cues for sleep-onset (parental presence and co-sleeping) are directly amenable to prevention. Importantly, disorganised sleep-state organisation can also be targeted. Parents may be instructed how to modulate their interactions with their "disorganised" infant in order to assist the infant to become more organised.

CHAPTER TWELVE

DISCUSSION

The present research addressed some critical gaps in the research knowledge base of infant sleep in order to provide a framework for planning primary prevention of ISD. This involved conducting a longitudinal study to investigate the development of infant sleep patterns, the roles of parent and infant behaviours, and their relationship to these patterns as they evolved over the first year of life. This research was formulated according to predictions from processes described in France and Blampied's (1999) developmental models. Study One addressed questions related to the timing of prevention, and its results indicated that the optimal time for prevention of ISD is within the first 2 months of an infant's life. Study Two addressed how to intervene by identifying which of the parent and infant factors should be targeted in preventive intervention. Based on examination of predictor variables at 1 month, the *parent* behaviours of presence at sleep-onset and co-sleeping, together with the *infant* sleep-state organisation characteristic of frequent night awakenings, were able to successfully predict emergence of sleep disturbance at 6 months, while night awakenings and parental presence predicted ISD at 12 months. This research contributes to the existing literature by identifying: (i) specific parent behaviours of presence at initial sleep-onset and co-sleeping, and the infant behaviour of frequent awakenings which should be targeted; and, (ii) the ideal timing for preventive intervention.

This chapter first describes how the studies have satisfied Mrazek and Haggerty's (1994) criteria that were considered crucial in the planning of preventive intervention of ISD. The implications of this research as it pertains to developmental theory and practice are then described: first, by detailing how the studies support and inform the developmental theory of France and Blampied's (1999) models; and, secondly how they practically inform primary prevention of infant sleep disturbance. The chapter concludes with suggestions for future research.

12.1. THE DEGREE TO WHICH CRITERIA FOR PLANNING PREVENTION HAVE BEEN MET

Criteria relevant to planning preventive intervention for ISD were derived from Mrazek and Haggerty's (1994) framework for evaluating preventive interventions.

This thesis determined that a number of these criteria were relevant to providing a framework for planning primary prevention of ISD so it is methodologically rigorous and based on sound theory. The literature was reviewed to establish how well the following criteria were met: defining ISD and describing the population to be targeted for intervention; providing evidence that the target population is at risk of the disorder; providing evidence of risk factors and their role in the development of ISD; describing the developmental task which prevention should be based on; and, identifying a sound theoretical model to inform prevention. Previous research had met some criteria, while other criteria had not been met. Therefore it is relevant to ascertain whether the research presented here has sufficiently met these criteria of rigour, where other research has not.

12.1.1. Criterion 1: Identification of ISD and Description of the Target Population

Chapter One described how the pre-existing research has sufficiently met the first criterion. The target population is infants, for whom prevention is to be provided at the primary level. The target group were initially described as being infants less than 6 months of age, because this is when primary sleep disturbance is first defined. As a result of this research the target population for primary prevention are infants in their first two months. Ideally prevention should begin as early as possible in the first month.

12.1.2. Criterion 2: Demonstration that the Population is Actually at Risk of the Disorder

Study One provided two independent pieces of evidence that infants are at risk of developing ISD:

1. The longitudinal distribution of SBS scores demonstrated that 41% of the infants at 6 months of age demonstrated the emergence of sleep disturbance, and 33% were sleep-disturbed at 12 months. Evidence of the continuity of ISD over time was demonstrated by the stability in SBS scores from 2 to 12 months in Study One. Furthermore, Study Two, demonstrated the continuity in primary sleep disturbance in that 27% of the infants in the SD group at 6 months remained in the SD group at 12 months. Study Two provided little evidence of secondary SD. Only one infant in the NSD group at 6 months shifted to the SD group at 12 months. Additionally, of the total sample of 75 infants, only a further three shifted from the NSD at 6 months into the SD group at 12 months. This evidence for continuity provides support for the continuity of sleep disturbance in infants thus demonstrating the validity of the predications at 1 month for group membership at 6 and 12 months. Future research could separate the 12 month group into infants evidencing primary and secondary

sleep disturbance, and analyse the developmental pathways of these groups more closely.

2. Over the first 12 months, 35% of the parents intervened in their infant's sleep to manage what they perceived to be a disturbed pattern of sleep. Of these parents, 15% intervened prior to 6 months of age.

Only one previous study has reported a rate of ISD at 6 months (Scher, 1991), and two at 12 months (Scher, 1991; Scott & Richards, 1990). The rates in the present study support those of previous research, and also provide a benchmark against which the success of preventive intervention can now be assessed.

12.1.3. Criterion 3: Evidence of Risk Factors, and of their Role in the Development of ISD

For a risk factor to be valid, it must be shown to precede the onset of ISD, and demonstrate predication of ISD. This criterion was met in that:

1. Sleep disturbance in infants has been previously demonstrated to have a degree of continuity over infancy and well into middle childhood (Kataria et al., 1987; Pollock, 1992; Wolke et al., 1994; Zuckerman et al., 1987). Study One and Study Two further demonstrated continuity in ISD allowing for investigation of predictor variables. Study Two met the challenge of predicting the earliest age at which aspects of sleep and sleep regulation become predictive, and this was at 1 month of age.
2. The factors associated with ISD, and the variables that reinforce and maintain ISD, are well known (Adams & Rickert, 1989; Durand & Mindell, 1990; France, 1989; France & Hudson, 1993; Lawton et al, 1991; Mindell & Durand, 1993; Piazza & Fisher, 1991; Pritchard & Appleton, 1988; Sanders et al., 1984; Rickert & Johnson, 1988; Rolider & Van Houten, 1984). Only a longitudinal study could demonstrate the predictive associations of the role of factors associated with ISD. Study Two did this.

At as early as 1 month of age, a number of the major parent and infant variables identified in the developmental models (France & Blampied, 1999) demonstrated an association that preceded ISD at 6 and 12 months of age. These included four infant factors (total sleep time, night awakenings, sleep/wake transitions, LUSP), and four parent factors (parental interventions, presence at sleep-onset, placed down asleep, co-sleeping). Factors shown to precede ISD only at 12 months included two infant (LUSP, night awakenings) and three parent factors (parental interventions, presence at sleep-onset, and co-sleeping). These findings are in accord with those of previous

studies reporting an association between these factors and ISD (Anders et al., 1992; Adair et al., 1991; Adair et al., 1992; Bernal, 1973; Crowell et al., 1987; Johnson, 1991; Kataria et al., 1987; Lozoff et al., 1985; Scher et al., 1995; Van Tassel, 1985; Weissbluth et al., 1984; Zuckerman et al., 1987). Anders et al. were the only investigators to demonstrate a factor to precede ISD. This thesis established in Chapter Three that the associations reported by the majority of studies were concurrent with ISD, rather than preceding it.

Study Two contributes further to the literature by its use of discriminant function analysis which successfully identified factors that were predictive of ISD at 6 and 12 months. At 1 month of age, the factors of parental presence at sleep-onset, co-sleeping and frequent night awakenings, predicted membership at 6 months to either a group of infants with emerging sleep disturbance, or group with settled sleep. Whilst the two factors of parental presence at sleep-onset, and frequent awakenings predicted group membership at 12 months. These findings extend previous research by identifying factors that precede ISD, and predict ISD.

12.1.4. Criterion 4: Preventive Intervention Must be Based on a Relevant Developmental Task

Preventive intervention must be based on the relevant developmental task, in this case sleeping through the night. Review of the literature in Chapter Six, demonstrated that there was insufficient developmental data available from prior research to determine the age when infants first begin to sleep through the night. Study One established a normative base upon which to examine the developments in sleeping through the night in the first year. In investigating three different criteria for sleeping through the night, the results of the present study redefined the developmentally most suitable criterion as 8-hours, or more accurately, as sleeping uninterrupted for 8 hours at night. This is, the most suitable criterion compared to Moore and Ucko's midnight to 5:00 a.m. criterion, and a more stringent 10:00 p.m. to 6:00 a.m. criterion for sleeping through the night. This study provided retrospective validation for the past use of Moore and Ucko's (1957) criterion in that infants in this study did sleep through the night according to this criterion at the ages predicted by Moore and Ucko. However, infants were as likely to sleep for 8 hours as for the 5 hours, so 8 hours is the better criterion.

The dynamic changes in infant's sleep in the first two months, as demonstrated by the current research, provides four compelling reasons why prevention should ideally occur in the first month:

1. Study One demonstrated that 2 months of age is when infants are most likely to sleep through the night.

2. The most rapid developments in LUSP duration occur during the period from 1 to 2 months.
3. These developments are also reflected in the shift of SBS scores from 1 to 2 months, when several infants' high scores "shifted" to cluster around low scores indicating settled patterns of sleep.
4. Study Two demonstrated that at 1 month of age, certain infant and parent factors (described above) interact to predict sleep disturbance at 6 and at 12 months of age.

12.1.5. Criterion 5: A Theoretical Model Needs to be Identified

A theoretical model is required to inform the timing of preventive intervention, so that the specific factors to be manipulated are based on sound conceptual foundations. France and Blampied's (1999) developmental model meets this criterion by providing a sound theoretical explanation using both biopsychosocial and behavioural theories to describe the development in infant sleep patterns. Furthermore, these models provide a developmental framework containing suggested entry points for prevention. For this reason parts of the developmental models were amenable to direct testing, specifically the parent and infant behaviours that occur prior to ISD.

12.2. IMPLICATIONS OF THE FINDINGS

Implications for the Developmental Models (France & Blampied, 1999)

How the findings of Studies One and Two support and augment France and Blampied's (1999) developmental model are illustrated in Figure 12. The findings from this research extend the models by specifying when critical changes in the development of infant sleep occur, and the relationship of these patterns to parental behaviour. The results of the current study also permit the replacement of the generalised factors in France and Blampied's model with specific infant and parent variables. This modified model provides a framework for planning prevention for ISD because it identifies the multiple entry points and the specific parent behaviours to be targeted. While these may not all be illustrated on the model figure, they are described in the text.

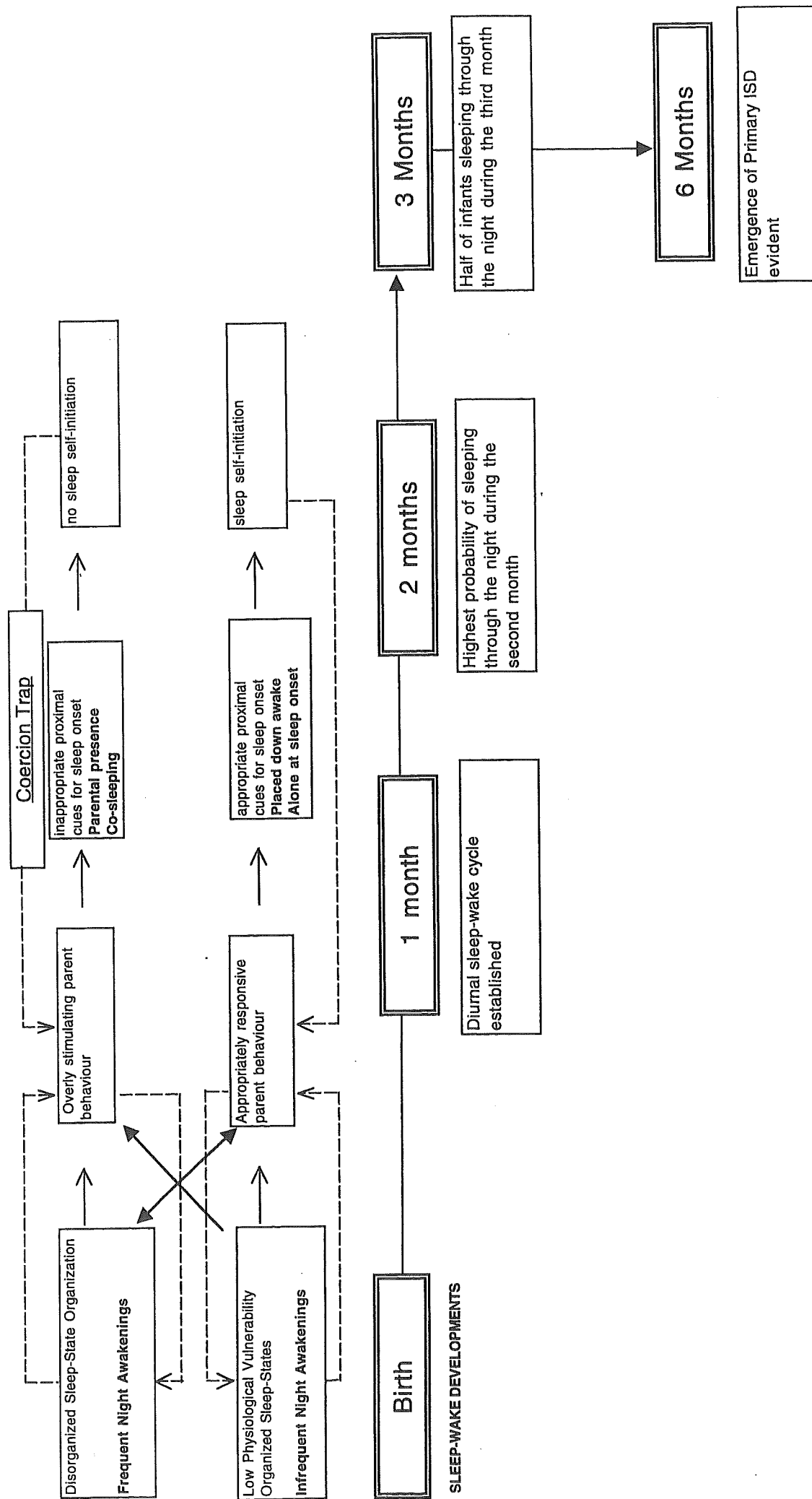


Figure 12. The establishment of sleep initiation problems during the first three months of life.

12.2.1. Developmental Changes in Sleep-Wake Organisation

The first addition to the model is that a clear diurnal cycle is established in the first month. That is, sleep at night is more continuous with less feeding than during the day. This supports studies that have reported a diurnal pattern to be established well within the first 2 months (Fukuda & Ishihara, 1997; Michelsson et al., 1990; Sadeh et al., 1996; Sostek et al., 1976; St-James Roberts, et al., 1996; Thoman & Whitney, 1989; Whitney & Thoman, 1994). By consolidating periods of sleep during the night at 1 month of age, infants have begun the first approximation towards sleeping through the night.

The second addition, occurs at 2 months when infants are most likely to begin sleeping through the night. This is earlier than the age of 3 months as specified in the model. Rather, it is in the third month that at least half of infants are reported to be sleeping through the night. This is also a fourth addition to the model. By 6 months of age, and as suggested by the model, infants will have developed into either a settled or an unsettled pattern of sleep. These developments in infant's sleep are determined by the effect of environmental events, and by infant sleep-state organisation.

12.2.2. Infant Characteristics and Parent Practices

One infant factor, disorganised sleep-state organisation, characterised by frequent night awakenings can be directly added to the model. So this study has supported the model's assertions that the infant's sleep-state organisation is important. Firstly, it was obvious in the infants of this study, as early as 1 month of age, that they had less organised sleep-states characterised by frequent night awakenings, that also predicted sleep disturbance at both 6 and 12 months of age. Whether it is likely to be the result of a constitutional factor as indicated in the model, or a consequence of early learning from parent-infant interaction may at this point, be irrelevant in planning preventive intervention. This supposed constitutional factor may well exist, but this research has shown that related parent behaviours also exist at the very early age of 1 month. This therefore suggests the very early development of a synergistic relationship rather than a linear relationship where one factor "causes" the other. This synergy is what Sadeh and Anders (1993) imply in their transactional systems model. Even if this were investigated earlier (i.e. during the pre-natal period) to establish which factor is doing the "driving", the problem of the relationship between disorganised sleep-states and parent behaviours may still exist, and would still have to be addressed in the first month of the infant's life.

Frequent night awakening can be targeted for preventive intervention as well as, or in concert, with parent behaviour. The strategies which parents can employ to assist infants in their maturation of sleep states draws on the literature describing the conditions under which sleep-state organisation proceeds more rapidly (see Chapter

Four). These are outlined in the section describing practical implications for prevention. Full consideration of this literature is outside of the scope of this thesis. Instead, the literature on sleep-state organisation belongs in the domain of future research where preventive intervention is actually conducted.

A fourth addition to the model are the parent behaviours of parental presence at initial sleep onset and co-sleeping. This research supports the model's assertion that parents provide inappropriate cues for infant's sleep-onset behaviour and thus assist in the development of ISD. While several other parent behaviours were shown to precede ISD, parental presence and co-sleeping assume prominence in the model. The remaining variables can also be added, but should assume a secondary position of influence.

The finding regarding parental presence at sleep-onset provides support for Blampied and France's (1993) theory of the underlying causal mechanisms determining the parent behaviours contributing to ISD. The probable causal explanation of these mechanisms has been described in detail in Chapters Three and Eleven.

France and Blampied (1999) suggest that infant vulnerabilities at 1 month, in this case disorganised sleep-state organisation, can result in parents developing certain styles of interaction that are either over-stimulating or appropriately responsive. France and Blampied suggest that these parent behaviours are determined in part, by characteristics of the infant, making parents vulnerable to engaging in over-stimulating behaviours. This may result from factors intrinsic to the parents that are established well prior to the infant's birth. Parental presence at sleep-onset, and co-sleeping, are both characteristics of over stimulating parental styles of care that parents use to assist the infant's transition to sleep, at initial onset and following a night awakening, and they were found to occur at 1 month of age. Therefore one needs a synergistic model which presumably allows multiple entry points, because infant behaviour will ultimately be influenced by parent behaviour. This model does this.

Given the early synergistic relationship demonstrated by this research between parent behaviours and infant sleep-state organisation, the interactions that determine sleep outcome (mainly primary ISD) at 6 and 12 months begins as early as 1 month of age. This is earlier than the 3 months suggested by France and Blampied (1999) in their second model. It is proposed that by 3 months, the behaviour traps during sleep-onset and following a night awakening, are already in effect. However, between the ages of 3 and 6 months the behaviour traps are strengthened according to processes described in the second model. One possible reason for this is that some parents may consider the first 3 months to be a period of development, adaptation, and change and they will provide whatever associations are necessary to assist the infant to initiate sleep. But, from around the age of 3 months, the parents' beliefs and expectations of their infant's sleep may change, in that they believe their infant should

be starting to settle or sleep through the night. Study Two provides evidence for this hypothesis, as 15% of the parents intervened in an attempt to better manage their infant's sleep pattern at an average age of 3.91 months.

12.3. IMPLICATIONS FOR PLANNING PRIMARY PREVENTION OF INFANT SLEEP DISTURBANCE

If there is a particularly undeveloped area of prevention science, it is here, at the point where prevention researchers have articulated the conditions they want to change, based on empirically developed theory, and are searching for methods to bring about this change.

Coie et al. (2000, p. 104)

Empirically validating France and Blampied's (1999) developmental model's predictions allows for the specific conditions that need to be changed for the prevention of ISD, and the methods for changing them. The implications of this research can now be translated into steps for planning primary prevention for ISD. It is also important that intervention adhere to ethical principals outlined by France (1989) for research conducted by the Canterbury Sleep Programme, which follow the "Doctrine of the Least Restrictive Alternative" as suggested by Cooper et al. (1987). These principles include: (i) parent intervention techniques must cause the least amount of distress to both the parents and infant; (ii) prevention of ISD is a better alternative to management intervention because it is less intrusive; and (iii) preventive intervention must occur at the developmentally optimum time.

12.3.1. Timing for Parent Training

One potential starting point for parent training is during the antenatal period, or the "transition to parenthood period" (Wolfson et al., 1992). Citing previous research, Wolfson et al. intimated that intervention during the transition phase would assist in reducing the negative and stressful events primiparous parents may experience. The results of their study supported this hypothesis, but whether or not this translates into long term benefits has yet to be established. Similarly, whether the pre- or post-natal period is the optimal time for instructing parents in preventive techniques has also yet to be established. It is conceivable that parents would be more receptive to instruction during the antenatal period, as they are not having to cope with a stressful period of disorganisation and disequilibrium following the arrival of a newborn (Beeghly, Brazelton, Flannery, Nugent, Barret & Tronick, 1995). Whether group training, or individualised instruction should be employed for preventive intervention is beyond the scope of this thesis, but should be addressed by sound

theory. Interventions can be implemented via various means, and different approaches should be addressed systematically to assess relative efficacy.

12.3.2. Timing for Preventive Intervention

Components of a preventive intervention programme must be designed in synchrony with normative developmental processes (Coie et al., 2000). On this basis, parents may wish to begin preventive strategies with their infants within the first month, and continue to do so particularly in the second and third months of life. This is because it is in the first month that the interaction of parent behaviours have been found to predict the quality of infant sleep first at 6 months and again at 12 months. This is also prior to when sleeping through the night is most likely to occur. Employing protective factors at this age that are incompatible with the identified risk factors would decrease the likelihood of parents assisting in the development of ISD. Parents would be assisting the infant in learning appropriate skills at a developmentally optimal time when infants first begin to acquire the skill of sleep-self initiation. It is also of immense developmental importance that prevention begins as early as possible in the first month with infants who have disorganised sleep-states. Parents may note these as being characterised by frequent night awakenings.

12.3.3. Implications for Teaching Parents Skills for Preventive Intervention

Reframing risk issues in terms of protection is more likely to make intervention palatable to consumers (Coie et al., 2000). In the case of infant sleep disturbance the predictor variables are easily reframed positively. For example, while parental presence at sleep-onset is a risk factor, limited parental absence would be a protective factor. Described below are the key components that parents could be trained in for preventive intervention.

This research has identified the most critical factor in the chain of appropriate stimulus control during initial sleep-onset to be allowing infants to fall asleep on their own, in their own sleeping place. This simultaneously targets the primary risk factor of parental presence at initial sleep-onset, and the secondary risk factor of placing an infant into the cot asleep. These two factors should not be treated as being separable. Targeting these two successive parts in the bedtime-chain or night awakening chain will expose the infants to the immediate bed environment and allow him/her the opportunity to develop appropriate stimulus control of sleep-onset from bed-, and not parent-related cues.

But this research has also established the complexity of infant/parent interactions and their systemic nature. The infant contributes to his/her own sleep development. By virtue of their physiology some infants may present more of a challenge to parents because they have less organised sleep-state organisation. On the

other hand, some parents may find parenting these infants an extra challenge because their own characteristics, e.g., anxiety, self doubt, and stress, may be exacerbated by their infants disorganised behaviour. Here the synergy of the process is clear. So what are the implications for prevention with these infants?

This research was also research which married developmental and operant concepts and each must be considered in the final implementation of a preventive intervention. From a developmental perspective simply applying the systematic ignoring used in management studies is not appropriate. How do we take operant concepts which have been operationalised with older infants and apply them sensitively to new parents and tender neonates?

With both of these questions we leave the direct findings of the studies and return to the literature on rapid development of sleep-state organisation which was reviewed by Blampied and France (1999), and was summarised briefly in Chapter Four. These authors stated "there is a growing and consistent body of evidence suggesting sleep-state organisation proceeds more rapidly under conditions of low and co-ordinated stimulation" (p. 269). They concluded from the research that better defined sleep and alert states, more quiet sleep, and less fussing and crying, occurred when the style of care for the infant is co-ordinated, rhythmic or of low-stimulation. Full review and investigation of this research was beyond the scope of the studies presented here however we can glean certain techniques which may clarify the process and allow parents to directly target sleep-state organisation as well as sleep behaviours.

Parents need to establish stimulus control early in the behaviour chain of going-to-bed and falling-asleep (Blampied & France, 1993). This translates into instructing parents in providing appropriate cues at each step of the chain for sleep-onset and reinitiation during the night. These might be providing diurnal cues that assist the infant in differentiating between night and day, thereby providing a regular sleep-wake time and placing the infant into the cot around the same time each day, and in an environment that can be consistently associated with bedtime. Thereby, the infant's circadian rhythms will become synchronised with the sleep-wake cycle (Piazza & Fisher, 1991), and one of the first steps in the approximation towards sleeping through the night is achieved.

During sleep-onset it is of critical importance that an environment conducive to behavioural quietude through conditions of low and co-ordinated stimulation is provided (France & Blampied, 1999). In order to do so parents must avoid over-stimulating infants, so they do not fall asleep, or habituate as a reaction to conditions of overwhelming arousal (Maurer & Maurer, 1988).

Parents need to recognise infant self-comforting such as consolability and hand-to-mouth behaviours (Karl, Beal & Rissmiller, 1995). Parents should refrain from interrupting this learning process thereby eliciting stress in the infant.

At sleep onset when the infant is fussy, the parents can give the baby a period of time to self-calm. Munck (1995) suggests this is an important alternative to "incessant motor restlessness and stimulation" (p. 108) whereby the parents can create more stress for the infant. Larson and Ayllon (1990) describe a process of "comfort-crying" whereby parents leave an unsettled infant to cry for brief periods, checking regularly.

If the infant is stressed, and the parents need to attend they can do so without overwhelming the baby with too much stimulation, or, not offering enough intervention to soothe him or her (Karl et al., 1995). Teaching parents calming manoeuvres as described in the Brazelton Neonatal Behavioural Assessment Scale (NABS) (Brazelton & Nugent, 1995) would be appropriate.

Parents can be taught to recognise infant states and keep their stimulation of the infant appropriate to the state. Karl et al. (1995) suggest that parents can help facilitate the infant during quiet alerting, by engaging in orienting activities when the infant is awake and receptive to interaction. Infants with disorganised sleep states may experience increased amounts of REM and therefore a greater number of arousals. Parents need to assist the infants toward the maturation of these states and one way is to establish that the infant is actually fully awake prior to interacting with him/her. Infants, may in fact, be experiencing an arousal (after which return to sleep is prompt) (Ferber, 1995). Parents should not unnecessarily awaken an infant from a sleep state. If the infant is not fully awake and the parental handling is sufficiently stimulating to fully awaken the infant then the parents "may become intimately involved in the sleep transition process" (Ferber, 1995, p. 80) thereby interrupting the process to maturation.

Care should be co-ordinated so that bathing, feeding and the like are performed in the same operation, and if at night quietly and in dimly lit surroundings.

During an infant's night awakening parents must engage in a minimally intrusive manner that is neither overly-stimulating, nor of an intensity that provides reinforcement for any signalling, or for remaining awake. After the parent has met the infant's nutritional and safety needs he or she must then decrease their attendance and allow the infant to fall asleep on their own. Crucially, where a young infant is in an 'insulated' crying state (i.e. state 6), he or she in fact needs stimulation to be decreased (Maurer & Maurer, 1988), and may appropriately be left alone for brief periods.

Parents who wish to prevent sleep disturbance need to understand that co-sleeping may exacerbate the problem and avoid bringing the infant into the parental bed in order to assist in the resumption of sleep.

Within the context of highly negative infant behaviour (irritable and persistent crying), St James-Roberts et al. (1998) suggested that practitioners need to advise and support parents so that their parenting practices are not disrupted by their infants' initially unrewarding behaviour. This suggestion also applies to parents whose infants frequently awaken throughout the night from birth, and who attempt to handle their infant in an optimal manner under challenging circumstances.

As the current research has been primarily concerned with primary prevention of ISD, the prevention of secondary sleep disturbance has not been considered. There is no reason why parents cannot use primary prevention strategies in the case of some event that is likely to disrupt the infants settled sleep pattern. These strategies can also potentially be derived from the third developmental model of France and Blampied (1999) which places emphasis on the management of sleep disturbance, where the principle of withdrawing reinforcing parental behaviours can be employed as described in the management literature (see Owens et al., 1999). Parents could employ the parental presence programme for problems at initial sleep-onset, and in response to night awakenings.

In conclusion, a number of steps translated from the findings of this study and the developmental models have been suggested for conducting preventive intervention. Because more than one risk factor was validated by this research, the prevention design must include components that address each of these. Any research attempting to implement these components must collect optimal outcome measures of the efficacy of preventive intervention.

How do these practical implications support or contradict intervention protocols employed by previous prevention studies? The timing and components of the parent education packages in the Wolfson et al. (1992) and Pinilla and Birch (1993) studies warrant comparison. Given that Pinilla and Birch subsequently modified Wolfson et al.'s study, the latter study will be considered. Parents in Wolfson et al.'s study were instructed in the behavioural principles of stimulus control at sleep-onset and minimal stimulation during night awakenings, but with the main emphasis on the component of focal feeding. One limitation of published studies, is that there may be insufficient space to elucidate on the specific techniques in which parents are instructed. Therefore, it is difficult to establish how much emphasis Wolfson et al. placed on establishing appropriate stimulus control of sleep-onset and on the principle of withdrawing attending parental behaviours. Therefore, except for the component of focal feeding, Wolfson et al. advocated several of the techniques (see Chapter Five), such as encouraging good "sleep hygiene", placing an infant into the cot awake, and without a parent present at initial sleep-onset, and allowing the infant some time to self-soothe before attending to a night awakening. Clearly, future research is warranted in comparing the efficacy of focal feeding alone, in combination with the

strategies described above, and then with the individual preventive strategies. Comparison cannot be made with either the Goodlin-Jones et al. (1997) study because they did not employ any component of parent-infant interaction, nor with the Kerr et al. (1996) study because they did not specify how the parent should intervene. The findings of this research support the components Adair et al. (1992) advocated for appropriate cues for initial sleep onset. What this research has established is these parent behaviours must be targeted from birth, because the effect of these early interaction are evident before 4 months, when Adair et al. began their intervention.

12.4. THE UNIQUE CONTRIBUTIONS OF THIS RESEARCH TO THE AREA OF INFANT SLEEP

This research is unique in a number of ways. It is one of the first studies in the area of infant sleep to employ prospective measures at each successive age over the first 12 months of life, to collect follow-up data, and to employ an objective measure against which to assess the reliability of parent report. The longitudinal design permitted infant and parent sleep variables to be measured at successive age points over the first year of life. This is compared with studies which have in the main, employed cross-sectional designs (Anders, 1979; Armstrong et al., 1994; Michelsson et al., 1990; Scher et al., 1995; Scott & Richards, 1990; Weissbluth, 1984), or studies that have collected data at varying ages (Anders et al., 1992; Anders & Keener, 1985; Anders et al., 1983; Scher, 1991; Van Tassel, 1985; Wolke et al., 1994, 1995a). The longitudinal design also allows analysis of the changes in infant and parent behaviours, and the identification of factors that precede and are potentially predictive of ISD. Had the findings not been identified at 1 month, it would have been possible to analyse the data at 2 months and so on, until the age could be identified at which association and predictions could be made. To date, the two longitudinal studies conducted by Anders et al. (1992) and Anders et al. (1983) have offered the most informed developmental data on normal infants' sleep, specifically in the direct measures of sleep-state architecture. Anders et al. (1992) collected data at only 3 ages, and the Anders et al. (1983) collected data at intermittent ages in the first year, and followed half of the sample from the second half of the year. Similarly, Scher (1991) and Wolke (1995a) conducted longitudinal investigations respectively from 3 and 5 months, but not during the intervening age points.

The second unique aspect was the wide range of parent and infant behaviours measured. Because ISD is such a complex phenomenon, no single variable, nor explanatory model can fully encompass its development. Explanatory models have predicted numerous factors as causal in the development of ISD (Blampied & France, 1993; France & Blampied, 1999; Messer & Richards, 1993; Sadeh & Anders, 1993).

Clearly any attempt to establish a causal role in either the parent or infant behaviours necessitates investigating as many factors as possible, as early as possible. Studies have, however, tended to: (i) examine only 1 or 2 sleep behaviours (Elias et al., 1986); (ii) investigate numerous factors and their association with ISD, but with older infants (Crowell et al., 1987; Kataria et al., 1987; Michelsson et al., 1990; Scher, 1991; Scher et al., 1995; Scott & Richards, 1990; Pollock, 1992; Van Tassel, 1985; Wolke et al., 1995a, 1994; Zuckerman et al., 1987); or (iii) investigate several infant sleep variables but few parent variables (Anders et al., 1983; Bamford et al., 1990; Keener et al., 1988).

The third unique aspect was the use of: (i) discriminant function analysis to predict ISD, and (ii) survival analysis to establish at what age infants first begin to sleep through the night.

Lastly, and most importantly, this study tested France and Blampied's (1999) first two explanatory models of ISD. These findings support and extend their developmental model and have important implications for providing a theoretical basis upon which to conduct prevention.

12.5. LIMITATIONS

There are a number of limitations in this research. These are the demographic composition of the sample, the use of parent report, the lack of parental ratings of ISD, the criterion employed for ISD, and lack of measures of parent malaise, and measures that may have been employed earlier.

The parents who volunteered for the current research were generally a fairly homogenous sample. They were generally well-educated, middle class, and predominantly Caucasian. They consisted of two-parent families, and gave the appearance of being well-motivated. Other than those parents who identified themselves as Maori, no families from other ethnic groups were among those who volunteered for the study. The number who identified as Maori was representative of the Canterbury population but low compared with New Zealand norms. Other ethnic groups characteristic of Canterbury, such as Asians for example, were not represented. It was, therefore, not possible to report or compare differences in the consolidation of sleep that could be attributed to specific cultural practices. These findings may reduce the generalisability of the results to families with lower socio-economic status, single-parent families, and families of different ethnicity. It was notable that parents who self-reported depression, as well as parents who could not cope with an infant's highly disruptive sleep, typified the characteristics of the non-responders. These parents need to be targeted for inclusion in future research.

Maintaining these parents in longitudinal research will, however, provide a challenge to researchers.

The findings of this study are based on parent report, although with TLVR reliability, and as a subjective measure it can be problematic. Some researchers in the field are highly critical of using parent report to measure infant sleep behaviour (Anders et al., 1992; Keener et al., 1988; Sadeh, 1994; Sadeh, 1996). These criticisms concern perceived inaccuracies arising from parents' under reporting of night awakenings in good sleepers (Minde et al., 1993; Sadeh, 1996; Sadeh, 1994), and overestimating the duration of sleep (from sleep-onset until the morning) (Sadeh, 1996). This is despite the fact that Sadeh (1994) failed to find such an effect.

Relying on the accuracy of parent report can be problematic in other ways. Unless parents complete the events as they happen in the diary, it then becomes retrospective report. Despite the parents' best intentions, it is unlikely, that for example every awakening and parental intervention were recorded. Parents may have perceived that this research was interested in a particular pattern of infant sleep and recorded events to reflect this. In addition, there is a vast amount of popular literature advocating appropriate sleep-onset associations (e.g. Ezzo & Bucknam, 1995; Ferber, 1985, Symon 1998), and our local Community Plunket Nurses are also strong advocates of techniques for establishing appropriate sleep-onset associations. Parents may have felt compelled to report in this direction.

Evidence, however, was provided to some degree, for the reliability of parent report. The reliability data between the TLVR and parent-report diaries was consistently high for each of the four variables (ranging between 93% to 98%). The LUSP durations, and the rates in sleeping through the night are comparable to those in studies directly measuring these variables (Anders, 1979; Anders et al., 1983; Anders & Keener, 1985). When describing the developmental progression in sleeping through the night, the criticisms articulated in other studies may not be relevant. This simply is because parents who underestimate night awakenings do so because they are reporting the LUSP and not the LSP. Night awakening visible on the TLVR or actigraph may not be audible to parents, because their infant has settled sleep. The present study therefore, to a large degree supports Scher et al.'s (1995) claim that parent report of infant sleep has ecological and developmental validity.

Parents were not asked whether they thought their infant had sleep disturbance. This information would have been useful as it would have allowed for comparison against the rates of ISD employed by the study, and determined what parents consider problematic infant sleep to be. The reason it was not collected was in order to avoid contaminating the data. This was because we believe that parents may have provided responses they considered were desirable to the researcher. They may have perceived that the research was interested in either settled or problematic sleep

patterns, and completed diaries to reflect this bias. In fact, the data was affected to some extent by this problem in that a number of parents did not complete diaries because they considered that their infant's continued settled pattern of sleep would be of no interest to the researcher (this was definitely not the case!).

There are also problems with the arbitrary cut-off at 6 and 12 months. Further research is necessary for item analysis pertaining to the developmental appropriateness of these ages, and whether in fact the cut-off score actually reflects settled or unsettled infant sleep. There is also the problem of dichotomising infants as sleep disturbed or not. Infant behaviour is dynamic, and is subject to developmental fluctuations throughout the first year. This suggests a need for a more flexible system in order for criteria to identify those infants who move between SD and NSD groups throughout infancy, as well as those infants who develop settled or unsettled sleep and remain so.

The other limitations of this study, are in fact, determined by how this research would have been conducted differently given the circumstances. These are now considered under directions for future research.

12.6. DIRECTIONS FOR FUTURE RESEARCH

The logical next step in future research is conducting preventive intervention for ISD. Described is what I would do and what should be researched.

First, direct measures of the infant's sleep, such as the TLVR would be collected beginning in early infancy and then at regular intervals throughout the first year. This would assist in establishing whether an infant's sleep-state organisation matures more rapidly under the intervention conditions of low and co-ordinated stimulation (Blampied & France, 1993). Is it that the sleep architecture of these infants changes and they experience fewer complete arousals, or, is it that infants are in fact suppressing signalling behaviours following an arousal? Addressing these questions would provide further assist in untangling the influence that environmental events have on the development of infant sleep.

Second, measures of constitutional/physiological endowments, in particular the infants' temperament, as well as the characteristics of the parents prior to the birth of the infant need to be collected. Measures would describe parent attitudes and beliefs prior to the birth, followed by objective measures of infant temperament in the early neonatal period. This would assist to define in greater detail, the effects of the synergistic relationship and the various outcomes of all these factors and processes.

The contribution of behavioural features in the development of ISD requires investigation. There has been a large amount of research published on temperament and ISD, yet its causal status has not been established, although such a relationship

has been suggested by a number of leading researchers in the field (Anders et al., 1992; France & Blampied, 1999; Sadeh & Anders, 1993). We need to clarify whether infants who have disorganised sleep-state organisation also have behavioural features of "difficult" temperament.

An objective measure such as the NABS (Brazelton & Nugent, 1995) could be used to examine infants' behavioural repertoire, or behavioural style. This measure can be used in the first few week of life, so that measures collected could avoid the problems of relying solely on subjective maternal report of infant temperament. (Halpern et al., 1994; Sadeh et al., 1994)

Addressing the issue of temperament and the development of ISD, would assist in clarifying Sadeh's (1994) yet unanswered, and critical question as to whether features of a difficult temperament influence ISD or whether disturbed sleep patterns influence difficult or negative infant features.

An important issue about child-rearing attitudes is how they relate to parent behaviour (Holden, 1995). Few studies have reported whether parent attitudes predict parent behaviour (Holden, 1995). In the case of infant sleep, research needs to address how prenatal parental beliefs and attitudes actually relate to parental behaviour once the infant is born. Sensitive measures of parenting beliefs, and attitudes about child rearing, must be collected prior to the birth of the baby. This is crucial because whether parents change their attitudes once the infant is born and whether these changes are determined by the features of the infants behaviour are lynchpins in finally elucidating the synergistic process.

A number of the non-responders in this research self-reported depression, and this was the primary reason the mothers withdrew their infants from the study. It is important that parents with depression be included in research. Perhaps recruiting these parents during the ante-natal period, and maintaining contact in a supportive role, could encourage these parents to remain in the study. Clearly, measures of maternal depression/or malaise must be collected. The causal status of this factor has yet to be established, and investigation of the direction of this relationship will present a challenge. One reason is that the relationship between sleep deprivation and postnatal depression remains unclear (Armstrong et al., 1998a). Is maternal mood induced by the infant sleep pattern or, is it that the infants' sleep pattern is induced by maternal mood? Contradictory findings have been reported thus far (Scott & Richards, 1990; Zuckerman et al., 1987). Further justification for research in this area was raised by Armstrong et al. (1998a) who suggested that some mothers diagnosed with post natal depression are, in fact, experiencing sleep deprivation. Maternal attendance to night awakenings results in disrupted sleep patterns and a reduced amount of total sleep. Lack of sleep can result in chronic sleep deprivation, and this condition "...may produce symptomology easily confused with that described as

postnatal depression" (Armstrong et al., 1998a, p. 262). Many women whose main problem is sleep deprivation, may receive treatment for post natal depression that is unnecessary and possibly harmful (Armstrong et al., 1998a). A measure of depression that places little emphasis on maternal sleep as a diagnostic criterion could be employed by future studies, so that it is depression, rather than the effects of maternal sleep deprivation, that are analysed.

This research has striven to fill some of the important gaps in the research necessary for conducting effective primary prevention for ISD in an attempt to ensure that it can rest on a sound conceptual and empirical foundation. Completing these gaps has not only academic relevance, but it also has practical relevance for parents of young infants. Areas for further research have been suggested that would advance current understanding, but these would involve comprehensive research programmes that are expensive in regard to both resources and time.

Planning for the prevention of infant sleep disturbance has been approached from a "negative" perspective, by looking at the ways in which parents and infants contribute to a problematic sleep pattern. It is worthwhile to conclude on a more positive note. Promoting prevention interventions should be one of the ultimate aims of family intervention research. It is a better alternative than treatment, and would assist in the optimal parenting that occurs when parents are well informed about their infants' development. A prevention programme derived from the developmental model (France & Blampied, 1999), consisting of several components promoted as protective factors timed to occur at specific entry points, and which are maintained at least throughout the first year of an infant's life, is necessary. Outcome data from this could then help to test current theory, and lead on to further research that could be implemented by health professionals in a community setting. Only then, as France (1989) concluded about her own research, will the full value of this thesis be realised.

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Appendix A

Flyers for Recruitment

**Education Department****University of Canterbury**

Private Bag 4800
Christchurch New Zealand
Telephone: 03-366 7001
Fax: 03-364 2418

CANTERBURY SLEEP PROGRAMME

The Canterbury Sleep Programme (CSP) is wanting to follow parents and their first babies from pregnancy through the first year of life. This is to gain information about their sleep patterns and development. If you would be willing to discuss taking part with us, please fill in the form below and Lynne, our CSP Research Nurse, will phone you.

Name: _____

Telephone Number: _____

Date Baby Due: _____

Lynne Hazlett, Research Nurse
3597-058



Education Department

University of Canterbury

Private Bag 4800
Christchurch New Zealand
Telephone: 03-366 7001
Fax: 03-364 2418

CANTERBURY SLEEP **PROGRAMME**

**WANTED: PARENTS WHO HAVE BABIES
AGED LESS THAN
TWO MONTHS FOR A STUDY ON INFANT
SLEEP PATTERNS**

The Canterbury Sleep Programme (CSP) is wanting to gain information on the development of infants' sleep patterns in the first year of life. All it takes is to fill in a simple sleep diary for six nights once a month. If you would like more information please phone Elizabeth, our research assistant at **3667 001 ext. 8214.**

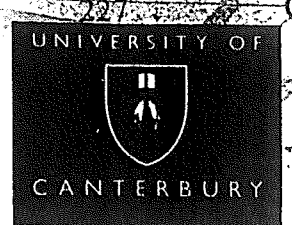
Appendix B

Ethical Approval

Department of Education

University of Canterbury
Private Bag 4800
Christchurch
New Zealand

Telephone: +64-3-364 2537 / +64-3-364 2209
Facsimile: +64-3-364 2418
Email: hod@educ.canterbury.ac.nz
Website: www.educ.canterbury.ac.nz



September 2001

Jacqueline Henderson PhD research: Ethical Cover

Ms Henderson's research was conducted within the Canterbury Sleep Programme using procedures established within this programme. Ethical approval for measures such as TLVR and diaries was obtained in 1992, further approvals for measures used in her research were obtained in 1995 and 1997.

In addition Ms Henderson has obtained approval, as required, by organisations referring participants to her research project.

A handwritten signature in cursive script, appearing to read "K. G. France".

Karyn G. France PhD, DipClinPsych, MNZCCPsych
Senior Lecturer
Principal Investigator Canterbury Sleep Programme
Supervisor

Appendix C

Parent's Information and Consent Sheets



Education Department

University of Canterbury

Private Bag 4800
Christchurch New Zealand
Telephone: 03-366 7001
Fax: 03-364 2418

Dear

Thank you for taking part in the Canterbury Sleep Project (CSP). Since 1981 the Canterbury Sleep Project has been investigating a concern of many parents - Infant Sleep Disturbance, and how to manage it. This part of the CSP aims to find out what are the ranges in infants' night time sleep behaviours in the first twelve months of life.

As you may know, new-born babies when they first come home sleep most of the day (16-20 hours), and as they get older they sleep less during the day and for longer periods in the night. What we are interested in finding out is the types of changes that occur in infant's sleep patterns, and when these changes occur. This will then help us to establish what the range is in sleeping patterns for infants of different ages. This information will provide invaluable help for the CSP to develop programmes for the prevention of infant sleep disturbance. It will also be used to inform parents and their professional advisers such as Doctors, Plunket Nurses and Psychologists.

In order to gather the information for this research you will complete a Sleep Diary for six consecutive days once a month for twelve months. When the diaries are completed please place them in the pre-stamped and addressed envelopes and post them.

Your part in the research is as follows.

- 1) To read the information sheet provided.
- 2) To answer some sociodemographic questions (parental age, occupation etc.).
- 3) To complete a Sleep Diary for six consecutive days once a month for twelve months, and provide the information you have gathered to the CSP.

The results of this study will be available to all participants, as well as Doctors, Plunket Nurses, and Psychologists.

Again thank you very much for helping us to learn more about babies' sleep development.

Yours sincerely

Jacki Henderson
Canterbury Sleep Programme



Education Department

University of Canterbury

Private Bag 4800
Christchurch New Zealand
Telephone: 03-366 7001
Fax: 03-364 2418

Canterbury Sleep Programme

Consent Form

1. If you wish to talk over your involvement in the research with someone else before you sign, please feel free.
2. I/we have read and understand the description of the research programme in the information sheet. On this basis, I/we agree to participate as subjects in the project.
3. I/we consent to publication of the results of the project with the understanding that anonymity will be preserved.
4. I/we understand that we are free to withdraw, with our child, from the programme at any point, without prejudice to any present or future treatment. This would include withdrawal of any information I/we have provided, should we wish.
5. If you have any queries or concerns regarding your rights as a participant in this research, you may wish to contact the Patient Advocacy Service, Ph 364 0581

Signed

.....
Parent

.....
Parent

.....
CSP staff

**Education Department****University of Canterbury**

Private Bag 4800
Christchurch New Zealand
Telephone: 03-366 7001
Fax: 03-364 2418

Canterbury Sleep Programme

Parents' Information and Consent Sheet

Thank you very much for your participation in the Canterbury Sleep Programme. The sleep diaries you have completed so far have provided some exciting and interesting information, which will be analysed in the very near future.

As you are aware, we have been measuring your infant's sleep patterns by asking you to record his/her sleep behaviours for six consecutive days once a month for twelve months. We would also like to measure your infants sleep state development for two nights only by recording your infants sleep patterns using and infrared, time lapse video camera.

In order to do this we will be using some well-established technology. Our low illumination, time-lapse video equipment is used to get a direct measure of your infant's sleep. It uses an invisible light source in order for filming to be unobtrusive. The camera will be mounted beside your child's cot. This allows us to film your child throughout the night without disturbing him or her. The time-lapse allows us to fit two nights of recording onto one tape. We will be measuring the amount of active and quiet sleep your baby has, as well as, when your infant wakes during the night and what he/she does when that happens. We code the sleep patterns by counting the number of times your infant moves during the night as well as by observing periods of wakefulness.

1. If you wish to talk over your involvement in this part of the research with someone else before you sign, feel free.
2. I/we have read and understand the description of the research programme in the information sheet above. On the basis, I/we agree to participate as subjects in the project.
3. I/we consent to publication of the results of the project with the understanding that anonymity will be preserved.
4. We agree to turn the video equipment on/off as instructed and to notify a Canterbury Sleep Programme contact person should the equipment develop any problems. I/we understand that the video equipment is not our responsibility.

5. I/we understand that we are free to withdraw, with our child, from the programme at any point, without prejudice to any present or future treatment. This would include withdrawal of any information I/we have provided, should we wish.
6. If you have any queries or concerns regarding your rights as a participant in this research, you may wish to contact the patient Advocacy Service, Ph. 364 0581.

Signed

.....
Parent

.....
Parent

.....
CSP Staff

Jacki Henderson
Home (03) 318 8714
Work (03) 366 7001 Extension 8214



Education Department

University of Canterbury

Private Bag 4800
Christchurch New Zealand
Telephone: 03-366 7001
Fax: 03-364 2418

THE CANTERBURY SLEEP PROGRAMME

Dear

*The Canterbury Sleep Programme would like to extend a big **thank you** for taking part in our study "Sleep patterns of New Zealand infants in the first year of life". We are very aware of how busy life is with a young baby (or two!!) in the house, and so we thoroughly appreciate the time and effort you have given in filling out the sleep diaries. Without your assistance and co-operation we would not be able to conduct this important study.*

*A number of mothers have said that their babies sleep patterns do not seem to have changed from month to month, and think it is not worth our time collecting these diaries. Let us reassure you that **every diary** is important. As you know, we are looking at how infant sleep patterns develop during the first year, and every diary helps us gain a clearer picture of how different sleep patterns develop. Knowing that some babies don't change is as important as knowing that some babies do. We are interested in **all** of your babies' sleep patterns, and the more information we can gather, the better the research!*

We have begun to look at some of the data from the sleep diaries and we are already getting some really exciting results. We hope to be able to share these with you within the next twelve months.

It has been of particular interest to read your comments on the diaries. If you think that there is a particular reason for your baby's sleep pattern please don't hesitate to write it down or to add a note. We are in the process of designing a new diary (thanks also for your suggestions) where there will be some room for you to note if there have been any changes during the time between diaries.

Thank you also to those families who have allowed us to take the time-lapse video camera into their homes. This video camera has an infrared light that enables us to directly record infants' sleep patterns in the dark. The camera doesn't make any noise or give out any light, and it tapes 24 hours worth of sleeping onto a 3-hour tape. If there is anyone else who may be interested in having the camera in their home for two nights then please let us know.

It is time to say farewell to Elizabeth Rathgen whose six-month contract with us has finished. Elizabeth has thoroughly enjoyed her contact with you. In the meantime, Jacki will be the contact person until our next research assistant begins. We will keep you informed. Elizabeth's leaving may mean the phone is not answered so reliably. We are arranging voice mail on the CSP phone number. So leave a message and we will phone back.

Once again, please accept this letter as personal thank you for all of your good work.

Kind Regards

Karyn France and Jacki Henderson



Education Department

University of Canterbury

Private Bag 4800
Christchurch New Zealand
Telephone: 03-366 7001
Fax: 03-364 2418

THE CANTERBURY SLEEP PROGRAMME

Dear

On behalf of the Canterbury Sleep Programme, I would like to extend a big thank you for all the time and effort you have given in filling out sleep diaries during the past twelve months. I know how busy life is when there is a young baby (or two!) in the house. Therefore, I am very grateful to you for the extra effort you have given in order to help us understand more about babies' sleep patterns.

You may be asking, what do we now know about infant sleep patterns that we didn't know twelve months ago? My first response to that question is that we now have a hundred more questions (well close) about babies' sleep patterns! Most of the information from the diaries has been entered onto the computer, and we are starting to get a picture of how different sleep patterns develop. What we have found so far is making us excited, as the results are very interesting.

A reporter from the newspaper persistently rings to find out about the results of the study, and, in July, these results will be presented at a conference in Brisbane. We shall also send you a summary of the results as soon as it is possible.

Once again please accept this letter as a personal thank you for your support and commitment to the Canterbury Sleep Programme.

Kind regards

Jacki Henderson
Canterbury Sleep Programme

Appendix E

Sleep Questionnaire

Child's name: _____ Date: _____

Please circle one choice for each question.

On average, over the last two weeks, how long has your child taken to settle after first placing in bed?

0 min 15 min 30 min 45 min 1 hour or more

How many nights has night waking occurred?

0 1-2 3-4 5-6 7 nights per week

How many times has he or she woken each night?

0 1-2 3-4 5-6 7 or more

When he or she woke, how much time was spent awake each night?

0 10 min 20 min 45 min 1 hour or more

How many hours sleep has your child had each day, i.e. day and night sleep minus wakings?

More than 12 11 10 9 8 or fewer hours

To what extent has your child had access to your bed?

Never	Only briefly, if awake, then back to his/her own bed.	We put him/her back once then allow him/her to stay in our bed the rest of the night.	He/she goes down in his/her bed but stays in our bed all night after first waking.	She/he goes down in our bed, we lie with him/her until asleep.
-------	---	---	--	--

We have used medication in order to help our child sleep

Not at all 1-2 nights 3-4 nights 5-6 nights 7 nights Weekly

Appendix F

Sleep Diaries

Child's name: _____

Week: _____

239

DAYTIME SLEEP

Date

Time down and where

Time awake

Time down and where

Time awake

Time down and where

Time awake

NIGHTSLEEP

How did you get Baby ready for bed

What time Baby first in cot

Was Baby awake or asleep

awake did Baby call out or cry

How long until settled

What did you do during this time

(see key)

Present when baby fell asleep

Hour and duration of awakening 1a.

What did you do when baby awake

(see key)

b.

KEY (for example)

2a.

/F=Breast or bottle feed

b.

/C=Nappy change

3a.

/B=Our bed

b.

=

=

4a.

b.

5a.

b.

6a.

b.

7a.

b.

Time awake in morning

SEE FOR INSTRUCTIONS

DAYTIME SLEEP

Date

Time down and where

Time awake

Time down and where

Time awake

Time down and where

Time awake

NIGHTSLEEP

How did you get Baby ready for bed

What time Baby first in cot

Was Baby awake or asleep

If awake did Baby call out or cry

How long until settled

What did you do during this time
(see key)

Present when baby fell asleep

Hour and duration of awakening 1a.

What did you do when baby awake
(see key)

KEY (for example)

B/F=Breast or bottle feed

N/C=Nappy change

O/B=Our bed

N = nothing

R = Rock

C = Cuddle

Time awake in morning

INSTRUCTIONS FOR DAY-TIME

Time down and where: What time

he/she went to sleep and where he/she went to sleep, this includes sleeps in the car, on peoples' laps etc.,

Time Awake: What time he/she awoke.

NIGHT-TIME SLEEP

How did you get baby ready for bed?: What you did or the routine you engaged in before putting him or her down for the night.

What time baby first in cot?: What time did you put him or her in the bed/cot for the night-time sleep.

Was the baby awake or asleep?: Was he or she awake or asleep when placed in the bed/cot.

If awake did he/she call out/cry?: Fill in type of sound.

For how long?: How long did she or he continue to call out or cry after being placed in the bed or cot.

What did you do?: Add to the Key by making up your own abbreviations for what you did to help settle your baby to sleep.

Present when baby fell asleep?: Was a parent with the baby when he or she fell to sleep? For example, if he/she fell asleep while being fed, in someone's arms, or on a sofa/mat etc., and went to bed asleep, or if someone sat or lay beside the cot until the baby fell asleep, answer yes.

Hour and duration of awakening: Write beside a. the hour when he or she was awake, and how long he or she was awake for.

What did you do?: Beside b. see number 6 above.

THANKYOU VERY MUCH FOR HELPING US LEARN MORE ABOUT BABIES SLEEP

Appendix G

Method of Computing Scores on the Sleep Behaviour Scale (From Richman, 1981)

Method of computing scores on the Sleep Behaviour Scale (From
Richman, 1981)

		Score		
Av. Time taken to sleep (Min)		or	Av. Bedtime (whichever is worse)	
<15		0	5-8.4 p.m.	
16-29		1	8.5-9.2 p.m.	
30-44		2	9.3-10 p.m.	
45-60		3	10.1-11 p.m.	
>60		4	After 11.0 p.m.	
Av total time slept at night in hours			Av. No. of nights waking per week	
12+		0	0-1	
11+		1	2	
10+		2	3	
9+		3	4-5	
<9		4	6	
Av. No. of wakings per night			Av. Time awake per waking (Min)	
<0.3		0	0-5	
0.4-1.0		1	6-15	
1.1-2.0		2	16-30	
2.1-3.0		3	31-60	
3.0		4	>60	
Av. Weekly hours in parents bed (No. Nights x Av. No. hours)			TOTAL SCORE	
None		0		
1-6		1		
7-20		2		
21-34		3		
35+		4		

Appendix H

T-tests Between the Two Groups at Age of Entry

t test calculations for between the group by age of entry

1 SBS scores and age at entry		
t-test between two entry groups		
t-Test: Two-Sample Assuming Unequal Variances		
Mean SBS scores		
	<i>1 month</i>	<i>2 months</i>
Mean	13.25490196	9.739130435
Variance	7.47372549	10.01976285
Observations	51	23
Hypothesized Mean Difference	0	
df	37	
t Stat	4.607761081	
P(T<=t) one-tail	2.35284E-05	
t Critical one-tail	1.687094482	
P(T<=t) two-tail	4.70569E-05	
t Critical two-tail	2.026190487	

2 t-test between two entry groups		
Moore and Ucko Criterion		
t-Test: Two-Sample Assuming Unequal Variances		
	<i>2mo</i>	<i>1mo</i>
Mean	4.368421053	3.659090909
Variance	8.69005848	7.985729387
Observations	19	44
Pearson Correlation	#N/A	
Pooled Variance	3.5	
df	32.94807653	
t	0.887449705	
P(T<=t) one-tail	0.190729316	
t Critical one-tail	1.693888407	
P(T<=t) two-tail	0.381458632	
t Critical two-tail	2.036931619	

3 8 hour		
t-Test: Two-Sample Assuming Unequal Variances		
	<i>2mo</i>	<i>1mo</i>
Mean	4.526315789	4.255813953
Variance	7.929824561	10.3734773
Observations	19	43
Pearson Correlation	#N/A	
Pooled Variance	3.5	
df	39.20857327	
t	0.33331773	
P(T<=t) one-tail	0.370339937	
t Critical one-tail	1.684875315	
P(T<=t) two-tail	0.740679874	
t Critical two-tail	2.022688932	

Appendix I

Life Tables

Survival Data of the infants meeting the 8 hours criterion (n=75)

Period (months)	Number of Infants That had not yet Experienced the Event at the Beginning of the Period	Number of Infants That Experienced the Event During the Period	Number of Infants That Were Censored at the End of the Period	Survival Probability at the End of the Period	Hazard of the Period
1	75	3	0	1.00	0.04
2	72	19	0	.96	0.28
3	53	13	0	.7067	0.27
4	40	8	0	.5333	0.20
5	32	3	0	.4267	0.09
6	29	3	0	.3867	0.10
7	26	4	0	.3467	0.15
8	22	0	0	.2933	0.02
9	22	3	0	.2867	0.13
10	19	2	0	.2476	0.10
11	17	2	0	.2215	0.11
12	15	4	11	.19	0.11

Survival Data of the infants meeting 10.00 p.m. to 6.00 a.m. criterion (n=75)

Period (months)	Number of Infants That had not yet Experienced the Event at the Beginning of the Period	Number of Infants That Experienced the Event During the Period	Number of Infants That Were Censored at the End of the Period	Survival Probability at the End of the Period	Hazard of the Period
1	75	0	0	1.00	0.01
2	75	12	0	.99	0.16
3	63	16	0	.83	0.27
4	47	7	0	.62	0.15
5	40	4	0	.53	0.10
6	36	1	0	.47	0.03
7	35	4	0	.46	0.11
8	31	1	0	.41	0.03
9	30	2	0	.39	0.06
10	28	3	0	.37	0.1
11	25	2	0	.33	0.07
12	23	2	21	.29	0.06

Survival Data of the infants meeting Moore and Ucko (1957) Criterion (n=75)

Period (months)	Number of Infants That had not yet Experienced the Event at the Beginning of the Period	Number of Infants That Experienced the Event During the Period	Number of Infants That Were Censored at the End of the Period	Survival Probability at the End of the Period	Hazard of the Period
1	75	6	0	0.99	0.08
2	69	24	0	0.91	0.42
3	45	8	0	0.59	0.19
4	37	9	0	0.49	0.28
5	28	5	0	0.37	0.20
6	23	1	0	0.30	0.04
7	22	3	0	0.29	0.15
8	19	1	0	0.25	0.05
9	18	2	0	0.23	0.12
10	16	2	0	0.21	0.13
11	14	2	0	0.18	0.15
12	12	1	11	0.15	0.14

Appendix J

Intervention

Nature of Parental interventions with infant less than 6 months

Intervention	N	Percent	
Left to cry*	6	75	
Medication	1	12.5	
Medication & Left to cry	0	0	
Controlled cry	3	37.5	
Oestopath	1	12.5	

Nature of Parental interventions with infant less than 6 months

Intervention	N	Percent	
Left to cry*	7	35	
Medication	3	10	
Medication & Left to cry	5	25	
Controlled cry	7	30	

* in conjunction with oosteopath

* in conjunction with weaning